FLUKE 1986
CATALOG

FLUKE

Certificate of Calibration

MODEL

SERIAL NO.

DATE

John Fluke Mfg. Co., Inc. certifies that this instrument has been calibrated using standards and instruments which are traceable to the National Bureau of Standards, or to nationally accepted measuring systems. The standards and instruments used in the calibration are supported by a calibration system which meets or exceeds the requirements of MIL-STD-45662. The reference standards which support this calibration system are calibrated on a schedule which is adjusted to maintain traceability at the required accuracy level. NBS Test Report numbers, or copies of those reports, can be obtained by contacting:

Standards Laboratory MS 169-G
John Fluke Mfg. Co., Inc.
P.O. Box C9090
Everett, Wa 98206

Les Huntley
Les Huntley
Metrology Assurance

FLUKE

SERVICE

Should one of your Fluke products require service, the Fluke Service Organization is ready to serve you. When returning an instrument to Fluke, please fill out this card and attach it to the product. With this information we can more effectively service your product and avoid unnecessary delays. Thank you!

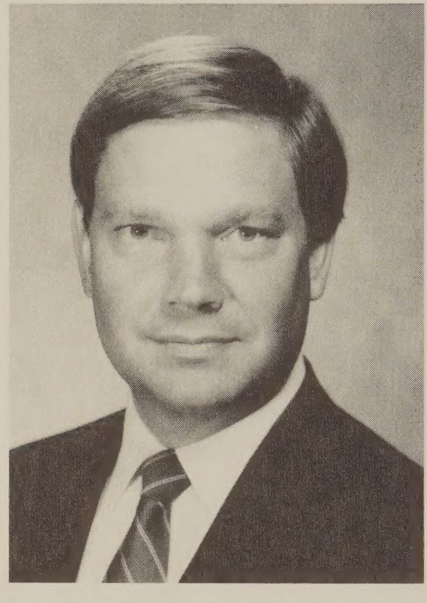
Company Name

Address

Technical Contact

Phone (

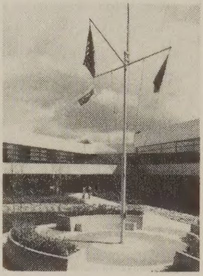
FLUKE



More than equipment...

In this catalog you'll find more than 250 pages of Fluke equipment—all of it designed in the tradition of excellence begun by John Fluke, Sr. in 1948. We're proud that Fluke equipment has been put to work by over 300,000 customers, and we're especially proud of the products we've introduced this year: the 8842A Digital Multimeter on page 3, the Models 21 and 23 Handheld Multimeters on page 42, the 6060B Synthesized Signal Generator on page 65, and the 1752A Data Acquisition System on page 193. All offer the performance and quality you'd expect from Fluke.

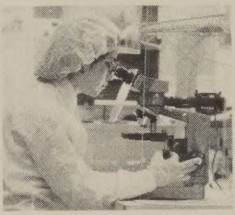
Because we make extensive use of our own products to satisfy our needs in R&D, product evaluation, field service, and in-plant data acquisition and control, it is accurate to say that Fluke products are defined, designed, manufactured, and supported by some of the most demanding users in the electronics industry. And, to ensure that your needs are not overlooked, we refine our understanding of your needs through intensive interaction with our customers and with our field sales and service people.



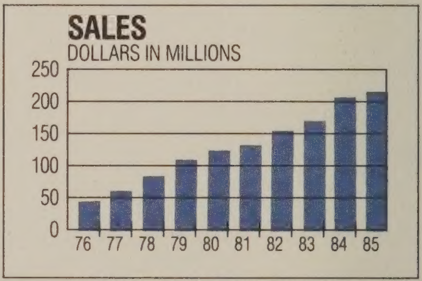
We also understand the critical function of maintaining electronic instrumentation used by electronic manufacturing companies, including the growing pressure to reduce the cost of such maintenance. This understanding will continue to be reflected in our emphasis on more effective calibration laboratory equipment and in products designed to reduce the need for periodic service.

If you are among many emerging users of electronic instrumentation in applications that have heretofore been non-electronic, Fluke has developed over the last decade a practical working knowledge of your special needs for support. Our new Fluke Cooperative Services program makes available third-party application assistance specialized in your field.

So, what you see in this catalog represents more than equipment you can count on. It represents a company with a dedication to after sales support you can count on as well.



It represents Fluke Labs that bring you the latest technology at the lowest cost. It represents Fluke Support Services to keep Fluke products working productively for you for the long run. And it represents a company that over its entire 37 year history has experienced continuous growth and profitability—your assurance that service and support will always be available to you.



We look forward to the opportunity to serve you. Thank you for considering Fluke.

John M. Fluke Jr.

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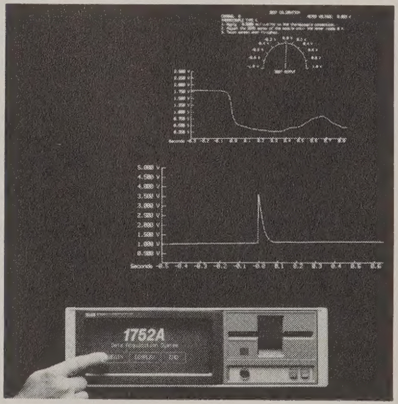

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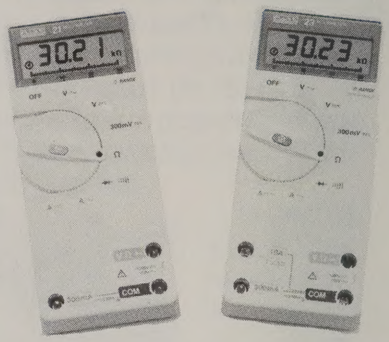

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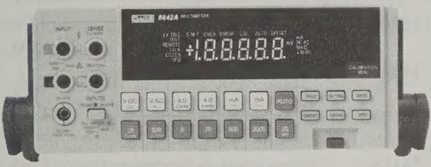

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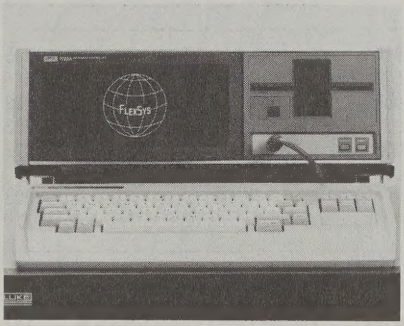

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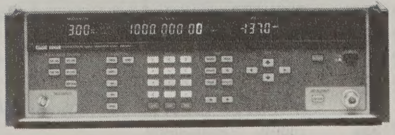

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* Distributor stock item
● IEEE-488
☐ RS-232-C

DIGITAL VOLTMETERS and DMMS

Introduction

Digital Voltmeters (DVMs) and Digital Multimeters (DMMs) are being employed in ever increasing numbers by professionals for industrial and research applications. Compared to other voltmeters and multimeters, DVMs and DMMs offer better speed, accuracy, resolution, and automatic readout. As a result, they reduce operator fatigue and errors.

Fluke DMMs range from inexpensive, handheld models to complex units for the most sophisticated systems applications in production or R & D.

A choice of either a 3½-, 4½-, 5½-, 6½-, or 7½-digit display provides the resolution and accuracy to fit the requirement. For recording measured data, many of the DMMs can be equipped with output interfaces.

Fluke system DVMs and DMMs feature options which allow a basic instrument to expand to meet the application. Accuracy and resolution will be a function of the model. System options provide remote control and data readout via equipment compatible with IEEE Std 488, EIA Standard RS-232-C, or Parallel (binary) and BCD interfaces.

Selection

To select a DMM for a given application, first determine what you will need to measure. Will it be dc voltage, ac voltage, dc current, ac current, resistance, or ratio? What range is required? What will be the accuracy, resolution, speed and sensitivity needed? Then consider the operating environment for restrictions on size and power (line or battery).

Calibration requirements, reliability, and cost must also be considered. The accompanying table compares the bench and system lines of Fluke digital voltmeters and multimeters.

For a comparison of Fluke handheld DMMs see the chart on page 35.

Selection Guide

	Basic Features			Special Features				Interfaces			DC Volts			AC Volts				AC/DC Amps		Ohms, etc.				
Models	Max Number of Digits	Display	Autoranging	Burst Memory	dB, dBm Readout	Offset/Relative Ref	Touch-Hold	IEEE-488	RS-232-C	Parallel/BCD	Basic 90 Day Accuracy, %	Max Resolution, µV	Max Voltage, w/o Probe	True-RMS	Basic 90 Day Accuracy, %	Max Resolution, µV	Frequency Range, Hz	Max Resolution, nA	Max Amps, w/o Probe	Max Resolution, mΩ	Max Resistance, MΩ	Diode Test	Conductance	Page
Bench / System Multimeters																								
8505A	7½	LED	*(1)*	—	—	●	—	▷	▷	▷	0.001	0.1	1200	▷	0.1	1.0	1M	0.1	1.28	0.01	265	—	—	10
8506A	7½	LED	*(1)*	—	—	●	—	▷	▷	▷	0.001	0.1	1200	●	0.016	1.0	1M	0.1	1.28	0.01	265	—	—	10
8500A	6½	LED	*(1)*	—	—	●	—	▷	▷	▷	0.001	1.0	1280	▷	0.1	10	1M	1.0	1.28	0.1	262	—	—	16
8502A	6½	LED	*(1)*	—	—	●	—	▷	▷	▷	0.001	1.0	1280	▷	0.1	10	1M	1.0	1.28	0.1	262	—	—	16
8520A	5½	LED	*(1)*	●	▷	●	—	●	—	—	0.005	1.0	1000	●	0.1	10	1M	—	*(3)*	0.1	20	—	●	19
8522A	5½	LED	*(1)*	●	●	●	—	—	—	●	0.005	1.0	1000	●	0.1	10	1M	—	*(3)*	0.1	20	—	●	19
8840A	5½	VF*	*(1)*	—	—	●	—	▷	—	—	0.004	1.0	1000	▷	0.14	1.0	100k	10k	2.0	1.0	20	—	—	2
8842A	5½	VF*	*(1)*	—	—	●	—	▷	—	—	0.0025	0.1	1000	▷	0.07	1.0	100k	1k	2.0	0.1	20	—	—	2
8840A/AF	5½	VF*	*(1)*	—	—	●	—	▷	—	—	0.004	1.0	1000	●	0.14	1.0	100k	10k	2.0	1.0	20	—	—	2
Bench / Portable Multimeters																								
8600A	4½	LED	*(1)*	—	—	—	—	▷	—	▷	0.02	10	1200	—	0.2	10	100k	10	2.0	10	20	—	—	23
8050A	4½	LCD	—	—	●	●	*(4)*	—	—	—	0.03**	10	1000	●	0.5	10	50k	10	2.0	10	20	●	●	28
8010A	3½	LCD	—	—	—	—	*(4)*	—	—	—	0.1**	100	1000	●	0.5	100	50k	100	10	100	20	●	●	31
8012A	3½	LCD	—	—	—	—	*(4)*	—	—	—	0.1**	100	1000	●	0.5	100	50k	100	2.0	1.0	20	●	●	31
Wideband True-RMS AC Digital Voltmeters																								
8920A	3½	LED	*(1)*	—	●	●	—	▷	—	▷	*(2)*	*(2)*	*(2)*	●	0.5	1.0	20M	—	*(3)*	—	—	—	—	25
8921A	3½	LED	*(1)*	—	●	●	—	▷	—	▷	*(2)*	*(2)*	*(2)*	●	0.5	1.0	20M	—	*(3)*	—	—	—	—	25
8922A	3½	LED	*(1)*	—	●	●	—	▷	—	▷	*(2)*	*(2)*	*(2)*	●	0.5	1.0	11M	—	*(3)*	—	—	—	—	25

● Standard
▷ Optional
**Vacuum fluorescent*

(1) Or manual ranging
(2) Will measure dc in ac-dc mode
*** 1-year accuracy*

(3) Use 80J-10 or A90 Shunt for up to 10A
(4) Use 80T-H Probe

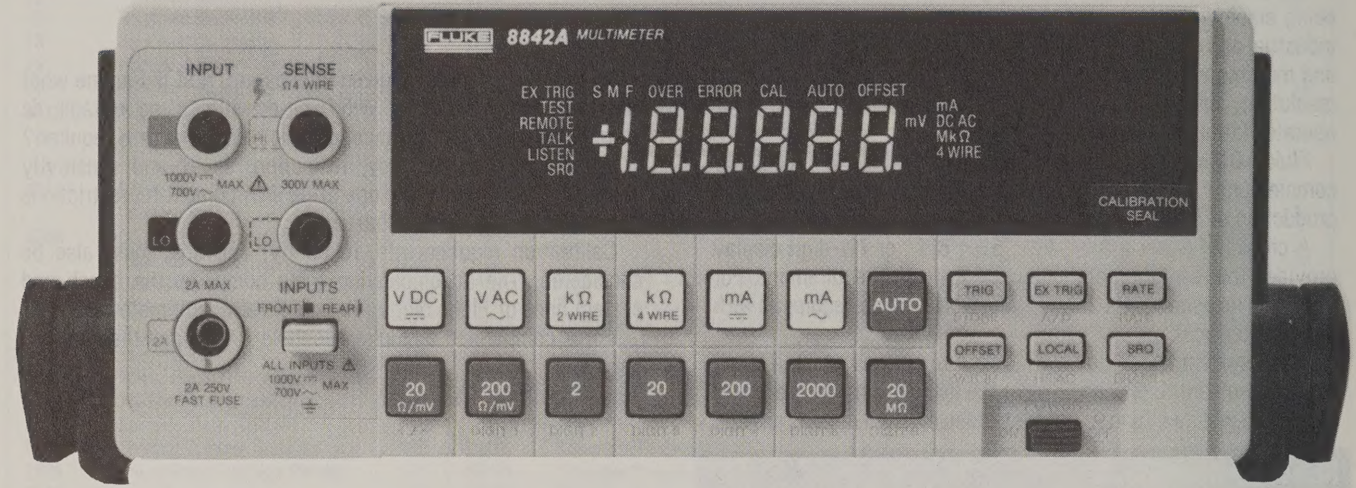
See also Handheld Multimeters beginning on page 35.

IEEE-488

DIGITAL MULTIMETERS

8840 Series

NEW



8842A

8840A Series: High Performance At Low Cost

- Basic 1-year dc accuracies to 0.003%
- Ohms and dc current standard
- Ac voltage and current optional
- Full system capability with optional IEEE-488 interface
- Up to 100 readings/second system speed
- Vacuum fluorescent display
- Closed-case calibration
- Comprehensive self test

The 8840 Series delivers new standards of accuracy, speed, resolution, and convenience in 5½-digit DMMs. They come with full dc voltage, current, and resistance capabilities, vacuum fluorescent displays, and offer optional true rms ac and IEEE-488 interface capabilities.

Performance

The 8840 Series has performance you would expect in multimeters costing much more. Basic dc accuracies to 0.003% and basic ac accuracies to 0.08% at one year are available. See the specifications that follow for complete information on measurement ranges and accuracy.

Closed-Case Calibration

No internal adjustments are required for calibration. After you initiate calibration via a recessed front panel switch, you are led through a software controlled procedure that even double checks to ensure that appropriate reference inputs have been applied. Calibration can be performed under front panel or IEEE-488 control.

Self Testing

The 8840 Series automatically performs a digital self test each time it is powered up. Additionally, you can initiate a comprehensive analog and digital diagnostic self test from the front panel or through the IEEE-488 interface.

Powerful System Capabilities

Adding the inexpensive IEEE-488 interface option to the 8840 Series provides system capability which includes complete system control of functions, ranges, and reading rates. Front and rear panel inputs are switch-selectable from the front panel (and you can sense the status of the switch over the bus). Calibration and self-test can also be controlled over the bus.

Powerful yet simple device dependent IEEE-488 code allows the 8840 Series DMMs to be easily integrated into your system. System software written for the 8840A is compatible with the new 8842A and 8840A/AF.

The mechanical design also contributes to performance and convenience in system applications. The 8840A Series' metal case provides EMI shielding to ensure measurement integrity. The unit can be mounted in a half-rack slot simply by removing the handle, turning the "twist-away" rear feet, and bolting on rack-mount brackets.

Embodying all these features, the 8840 Series DMMs are fully programmable, powerful digital multimeters within reach of every system builder.

Technology

A monolithic A/D converter uses CMOS IC design to achieve the superb accuracy, speed, and reliability of the 8840 Series.

Analog switch ICs developed by Fluke replace discrete switching devices to create superior performance, reliability, and serviceability.

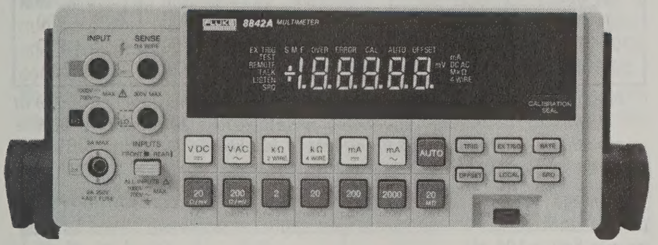
A voltage reference device similar to that found in the Fluke 732A DC Reference Standard provides unmatched stability.

Precision thin film resistor networks establish the accuracy and maintain the stability of the 8840 Series.

Call
1-800-44FLUKE
Extension 700 ☎

Now You Can Choose The 8840 Series DMM To Meet Your Performance Needs

NEW



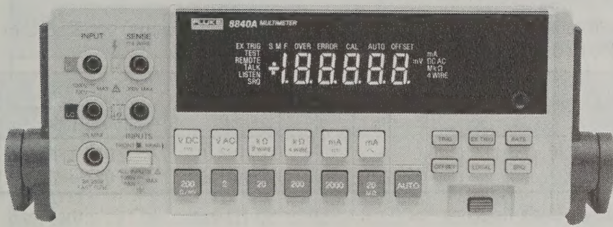
8842A

8842A: Premium Performance

The 8842A, top of the 8840 line, delivers all the features of the popular 8840A plus new hermetically sealed thin film resistors. These TFRs make possible:

- **Increased measurement power:**
  100 nV resolution with a 20 mV range
  1 μA resolution with a 200 mA range
  100 $\mu\Omega$ resolution with a 20Ω range
- **Enhanced accuracy in V dc, V ac, Ω**
  0.003% basic dc accuracy at 1 year
  0.08% basic ac accuracy at 1 year
  0.008% basic Ω accuracy at 1 year
- **Extended cal cycles, with 2 year specifications**
  0.005% basic dc accuracy at 2 years
- **Two year warranty**

See next page for detailed 8842A specifications.



8840A

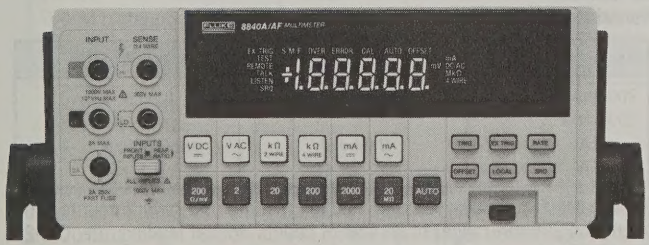
8840A: The Original Value Leader

The original 8840A continues to provide an outstanding combination of low price and high performance. These features, common to all members of the 8840 Series, are responsible for the popularity of the 8840A.

- 0.005% basic dc accuracy at 1 year
- Ease of IEEE-488 system integration
- Closed case calibration
- Extensive self test
- High reliability
- Vacuum fluorescent display.

Fluke's one year warranty applies. See page 6 for detailed specifications.

NEW



8840A/AF

8840A/AF: For Tough Assignments

The 8840A/AF delivers all of the 8840A capabilities, plus:

- Expanded environmental envelope
- Compliance with MIL-T-28800C Type II, Class 3, Style B
- DC/DC ratio capability in lieu of front/rear inputs
- True rms ac voltage/current capability is standard
- 1000V rms ac maximum allowable input
- Enhanced EMI/RFI protection.

National Stock Number is 6625-01-196-0014. Fluke's one year warranty applies. See page 8 for detailed specifications.

8842A

Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Resistance
		5½ Digits	4½ Digits*	
20 mV	19.9999 mV	0.1 μV	1 μV	⩾10,000 MΩ
200 mV	199.999 mV	1 μV	10 μV	⩾10,000 MΩ
2V	1.99999V	10 μV	100 μV	⩾10,000 MΩ
20V	19.9999V	100 μV	1 mV	⩾10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

*4½-digits at the fastest reading rate.

Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Range	24 Hour[1] 23±1°C	90 Day 23±5°C	1 Year 23±5°C	2 Year 23±5°C
20 mV[2]	0.0050 + 20	0.0070 + 30	0.0100 + 30	0.0120 + 40
200 mV[2]	0.0030 + 2	0.0045 + 3	0.0070 + 3	0.0100 + 4
2V	0.0015 + 2	0.0025 + 2	0.0030 + 2	0.0050 + 3
20V	0.0015 + 2	0.0030 + 2	0.0035 + 2	0.0060 + 3
200V	0.0015 + 2	0.0030 + 2	0.0035 + 2	0.0060 + 3
1000V	0.0020 + 2	0.0035 + 2	0.0045 + 2	0.0070 + 3

[1] Relative to calibration standards.
[2] Within one hour of dc zero, using offset control.

Medium and Fast Rates: In medium rate, add 2 counts (20 counts on 20 mV range) to number of counts. In fast rate, use 2 counts (20 counts on 20 mV range) for the number of counts

Operating Characteristics

Temperature Coefficient: >±(0.0006% of Reading + 0.3 Count) per °C from 18°C to 0°C and 28°C to 50°C
Maximum Input: 1000V dc or peak ac on any range
Noise Rejection: Automatically optimized at power-up for 50, 60 or 400 Hz

Rate	Readings/ Second[1]	Filter	NMRR[2]	Peak NM Signal	CMRR[3]
S	2.5[5]	Analog & Digital	>98 dB	20V or 2 x FS[4]	>140 dB
M	20[6]	Digital	>45 dB	1 x FS	>100 dB
F	100	None	—	1 x FS	>60 dB

[1] Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.
[2] Normal Mode Rejection Ratio, at 50 or 60 Hz ±0.1%. The NMRR for 400 Hz ±0.1% is 85 dB in S rate and 35 dB in M rate.
[3] Common Mode Rejection Ratio at 50 or 60 Hz ±0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.
[4] 20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V.
[5] Reading rate — .31 rdg/sec. in the 20 mV, 20Ω, 200 mA dc ranges.
[6] Reading rate — 1.25 rdg/sec. in the 20 mV, 20 Ω, 200 mA dc ranges.

True-RMS AC Voltage (Option 8842A-09)

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Impedance
		5½ Digits	4½ Digits*	
200 mV	199.999 mV	1 μV	10 μV	1 MΩ shunted by <100 pF
2V	1.99999V	10 μV	100 μV	
20V	19.9999V	100 μV	1 mV	
200V	199.999V	1 mV	10 mV	
700V	700.00V	10 mV	100 mV	

*4½-digits at the fastest reading rate.

Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)
For sinewave inputs ⩾10,000 counts[1]

Frequency (Hz)	24 Hours[2] 23±1°C	90 Day 23±5°C	1 Year 23±5°C	2 Year 23±5°C
20-45	1.2 + 100	1.2 + 100	1.2 + 100	1.2 + 100
45-200	0.3 + 100	0.35 + 100	0.4 + 100	0.5 + 100
200-20k				
(200 mV)	0.06 + 100	0.08 + 100	0.10 + 100	0.20 + 100
(2V-200V)	0.05 + 80	0.07 + 80	0.08 + 80	0.15 + 80
(700V)	0.06 + 100	0.08 + 100	0.10 + 100	0.20 + 100
20k-50k	0.15 + 120	0.19 + 150	0.21 + 200	0.25 + 250
50k-100k	0.4 + 300	0.5 + 300	0.5 + 400	0.5 + 500

[1] For sinewave inputs between 1,000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz.
[2] Relative to calibration standards.

Medium and Fast Reading Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ⩾1000 counts and >100 Hz
Nonsinusoidal Inputs: For nonsinusoidal inputs ⩾10,000 counts with frequency components ⩽100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	Crest Factor		
	1.0 to 1.5	1.5 to 2.0	2.0 to 3.0
45 Hz to 20 kHz	0.05	0.15	0.3
20 Hz to 45 Hz and 20 kHz to 50 kHz	0.2	0.7	1.5

Operating Characteristics

Maximum Input: 700V rms, 1000V peak or 2 x 10^7 Volts-Hertz product (whichever is less) for any range
Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz		
	20-20k	20k-50k	50k-100k
⩾10,000 counts	0.019 + 9	0.021 + 9	0.027 + 10
⩾1,000 counts	0.019 + 12	0.021 + 15	0.027 + 21

Common Mode Rejection: >60 dB at 50 or 60 Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale 5½ Digits	Resolution	
		5½ Digits	4½ Digits*
200 mA	199.999 mA	1 μA	10 μA
2000 mA	1999.99 mA	10 μA	100 μA

*4½ digits at the fastest reading rate.

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Range	90 Days 23±5°C	1 Year 23±5°C
200 mA	0.04 + 40	0.05 + 40
2000 mA		
⩽1A	0.04 + 4	0.05 + 4
>1A	0.1 + 4	0.1 + 4

Medium and Fast Reading rates: In medium reading rate, add 2 counts (20 counts on 200 mA range) to number of counts. In fast reading rate, use 2 counts (20 counts on 200 mA range) for number of counts

AC Accuracy (Requires Option 8842A-09)

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)
1 Year, 23°±5°C, for sinewave inputs ⩾10,000 counts

Frequency in Hertz		
20-45	**45-100**	**100-5k***
2.0 + 200	0.5 + 200	0.4 + 200

**Typically 20 kHz*

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ⩾1000 counts and frequencies >100 Hz, the accuracy is ± (0.2% of reading + 30 counts)

Nonsinusoidal Inputs: For nonsinusoidal inputs ⩾10,000 counts with frequency components ⩽100 kHz, add the following % of reading to the accuracy specifications

Fundamental Frequency	Crest Factor		
	1.0 to 1.5	**1.5 to 2.0**	**2.0 to 3.0**
45 Hz to 5 kHz	0.05	0.15	0.3
20 Hz to 45 Hz	0.2	0.7	1.5

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse

Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Current Through Unknown
		5½ Digits	**4½ Digits [1]**	
20Ω[2]	19.9999Ω	0.1 mΩ	1 mΩ	1 mA
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 μA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 μA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 μA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 μA

[1] 4½ digits at the fastest reading rate
[2] 4-wire ohms only

Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)[1]

Range	24 Hour[2] 23±1°C	90 Day 23±5°C	1 Year 23±5°C	2 Year 23±5°C
20Ω[3]	0.007 + 30	0.009 + 40	0.012 + 40	0.015 + 40
200Ω	0.0040 + 3	0.007 + 4	0.010 + 4	0.012 + 4
2 kΩ	0.0025 + 2	0.005 + 3	0.008 + 3	0.010 + 3
20 kΩ	0.0025 + 2	0.005 + 3	0.008 + 3	0.010 + 3
200 kΩ	0.0025 + 2	0.006 + 3	0.010 + 3	0.012 + 3
2000 kΩ	0.023 + 3	0.025 + 3	0.027 + 3	0.030 + 3
20 MΩ	0.023 + 3	0.040 + 4	0.042 + 4	0.050 + 4

[1] Within one hour of ohms zero, using offset control.
[2] Relative to calibration standards.
[3] 4-wire ohms only

Medium and Fast Reading Rates: In medium rate, add 2 counts to the number of counts for the 200Ω through 200 kΩ ranges, 3 counts for the 2000 kΩ and 20 MΩ ranges, and 20 counts for the 20Ω range. In fast reading rate, use 3 counts for the number of counts for the 200Ω range, 20 counts for the 20Ω range, and 2 counts for all other ranges

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

Measurement Configuration: 2-wire or 4-wire (20Ω range is 4-wire only)

Open Circuit Voltage: Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges

Input Protection: To 300V rms

Reading Rates and Ranging

Reading Rates With Internal Trigger (readings per second):

Rate	Power Line Frequency[1]		
	50 Hz	**60 Hz**	**400 Hz**
S	2.08 (.26[2])	2.5 (.31[2])	2.38 (.30[2])
M	16.7 (1.04[2])	20 (1.25[2])	19.0 (1.19[2])
F	100	100	100

[1] Sensed automatically at power-up.
[2] In the 20 mV, 20Ω, and 200 mA ranges. The 8842A does not autorange down into these ranges. To access these ranges, select the specific range, from the front panel or over the bus.

General Specifications

Option -05 IEEE-488 Interface Function: Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0

Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground

Temperature Range: 0°C to 50°C operating; -40°C to 70°C storage

Humidity Range: 80% RH from 0 to 35°C; 70% to 50°C

Warmup Time: 1 hour to rated specifications

Power: 100, 120, 220, or 240V ac ±10% (250V ac maximum), switch selectable at rear panel; 50, 60, or 400 Hz, automatically sensed at power up; 20 VA maximum

Vibration: Meets requirements of MIL-T-28800C for Type III, Class 3, Style E equipment

Protection: ANSI C39.5 and IEC 348, Class I

Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.5 in x 8.5 in x 14.6 in)

Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)

Warranty Period: Two years

Included: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, and instrument performance record

Model

	January 1986 prices
8842A Digital Multimeter	$995

Options

8842A-05 IEEE-488 Interface	150
8842A-05K Field Installable IEEE-488 Interface	170
8842A-09 True-RMS AC	250
8842A-09K Field Installable True-RMS AC	270

Accessories (Also see page 57)

Y8834 Single Rack Mount Kit	35
Y8835 Dual Rack Mount	75
Y8836 Center Rack Mount Kit	125
Y8021 1m IEEE-488 Shielded Cable	85
Y8022 2m IEEE-488 Shielded Cable	95
Y8023 4m IEEE-488 Shielded Cable	105
Y8077 Four Terminal Short	30
A90 6-Range Current Shunt	595

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Resistance
		5½ Digits	4½ Digits	
200 mV	199.999 mV	1 µV	10 µV	≥10,000 MΩ
2V	1.99999V	10 µV	100 µV	≥10,000 MΩ
20V	19.9999V	100 µV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

**4½-digits at the fastest reading rate.*

Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Range	24 Hour* 23±1°C	90 Day 23±5°C	1 Year 23±5°C
200 mV**	0.003 + 3	0.007 + 4	0.008 + 4
2V	0.002 + 2	0.004 + 3	0.005 + 3
20V	0.002 + 2	0.005 + 3	0.006 + 3
200V	0.002 + 2	0.005 + 3	0.006 + 3
1000V	0.003 + 2	0.005 + 3	0.007 + 3

**Relative to calibration standards.*
***Using Offset control*

Medium and Fast Rates: In medium rate, add 2 counts to number of counts. In fast rate, use 2 counts for the number of counts

Operating Characteristics

Temperature Coefficient: >±(0.0006% of Reading + 0.3 Count) per °C from 18°C to 0°C and 28°C to 50°C
Maximum Input: 1000V dc or peak ac on any range
Noise Rejection: Automatically optimized at power-up for 50, 60 or 400 Hz

Rate	Readings/ Second[1]	Filter	NMRR[2]	Peak NM Signal	CMRR[3]
S	2.5	Analog & Digital	>98 dB	20V or 2 x FS[4]	>140 dB
M	20	Digital	>45 dB	1 x FS	>100 dB
F	100	None	—	1 x FS	>60 dB

[1] Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.
[2] Normal Mode Rejection Ratio, at 50 or 60 Hz ±0.1%. The NMRR for 400 Hz ±0.1% is 85 dB in S rate and 35 dB in M rate.
[3] Common Mode Rejection Ratio at 50 or 60 Hz ±0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.
[4] 20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V.

True-RMS AC Voltage Option (8840A-09)

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Impedance
		5½ Digits	4½ Digits*	
200 mV	199.999 mV	1 µV	10 µV	1 MΩ shunted by <100 pF
2V	1.99999V	10 µV	100 µV	
20V	19.9999V	100 µV	1 mV	
200V	199.999V	1 mV	10 mV	
700V	700.00V	10 mV	100 mV	

**4½-digits at the fastest reading rate.*

Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)
For sinewave inputs ≥10,000 counts[1]

Frequency (Hz)	24 Hours[2] 23±1°C	90 Day 23±5°C	1 Year 23±5°C
20-45	1.2 + 100	1.2 + 100	1.2 + 100
45-100	0.3 + 100	0.35 + 100	0.4 + 100
100-20k	0.07 + 100	0.14 + 100	0.16 + 100
20k-50k	0.15 + 120	0.19 + 150	0.21 + 200
50k-100k	0.4 + 300	0.5 + 300	0.5 + 400

[1] For sinewave inputs between 1,000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz.
[2] Relative to calibration standards.

Medium and Fast Reading Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 counts and >100 Hz

Operating Characteristics

Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

For Inputs	Frequency in Hertz		
	20-20k	20k-50k	50k-100k
≥10,000 counts	0.019 + 9	0.021 + 9	0.027 + 10
≥1,000 counts	0.019 + 12	0.021 + 15	0.027 + 21

Crest Factor

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, and the following % of reading to the accuracy specifications

Fundamental Frequency	1.0 to 1.5	1.5 to 2.0	2.0 to 3.0
45 Hz to 20 kHz	0.05	0.15	0.3
20 Hz to 45 Hz and 20 kHz to 50 kHz	0.2	0.7	1.5

Maximum Input: 700V rms, 1000V peak or 2 x 10^7 Volts-Hertz product (whichever is less) for any range
Common Mode Rejection: >60 dB at 50 or 60 Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale 5½ Digits	Resolution	
		5½ Digits	4½ Digits*
2000 mA	1999.99 mA	10 µA	100 µA

**4½ digits at the fastest reading rate.*

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Current	90 Days 23±5°C	1 Year 23±5°C
≤1A	0.04 + 4	0.05 + 4
>1A	0.1 + 4	0.1 + 4

Medium and Fast Reading Rates: In medium reading rate, add 2 counts to number of counts. In fast reading rate, use 2 counts for number of counts

AC Accuracy (Requires Option 8840A-09)
Normal (S) Reading Rate: ±(% of Reading + Number of Counts)
1 Year, 23°±5°C, for sinewave inputs ≥10,000 counts

Frequency in Hertz		
20-45	45-100	100-5k*
2.0 + 200	0.5 + 200	0.4 + 200

Typically 20 kHz

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 counts and frequencies >100 Hz, the accuracy is ±(0.2% of reading + 30 counts)

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C
Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse
Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Current Through Unknown
		5½ Digits	4½ Digits*	
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1Ω	100 μA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 μA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 μA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 μA

**4½ digits at the fastest reading rate*

Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)[1]

Range	24 Hour[2] 23±1°C	90 Day 23±5°C	1 Year 23±5°C
200Ω	0.004 + 3	0.011 + 4	0.014 + 4
2 kΩ	0.0028 + 2	0.01 + 3	0.013 + 3
20 kΩ	0.0028 + 2	0.01 + 3	0.013 + 3
200 kΩ	0.0028 + 2	0.01 + 3	0.013 + 3
2000 kΩ	0.023 + 3	0.027 + 3	0.028 + 3
20 MΩ	0.023 + 3	0.043 + 4	0.044 + 4

[1] Using Offset control.
[2] Relative to calibration standards.

Medium and Fast Reading Rates: In medium rate, add to the number of counts 2 counts for the 200Ω through 200 kΩ ranges and 3 counts for the 2000 kΩ and 20 MΩ ranges. In fast reading rate, use for the number of counts 3 counts for the 200Ω range and 2 counts for all other ranges

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 0°C to 18°C and 28°C to 50°C
Measurement Configuration: 2-wire or 4-wire
Open Circuit Voltage: Less than 6.5V on the 200Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges
Input Protection: To 300V rms

Reading Rates:

Reading Rates With Internal Trigger (readings per second):

Rate	Power Line Frequency[1]		
	50 Hz	60 Hz	400 Hz
S	2.08	2.5	2.38
M	16.7	20	19.0
F	100	100	100

**Sensed automatically at power-up*

General Specifications

Option -05 IEEE-488 Interface Function: Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0
Common Mode Voltage: 1000V dc or peak ac, or 700V rms ac from any input to earth ground
Temperature Range: 0°C to 50°C operating; -40°C to 70°C storage
Humidity Range: 80% RH from 0 to 35°C; 70% to 50°C
Warmup Time: 1 hour to rated specifications
Power: 100, 120, 220, or 240V ac ±10% (250V ac maximum), switch selectable at rear panel; 50, 60, or 400 Hz, automatically sensed at power up; 20 VA maximum
Vibration: Meets requirements of MIL-T-28800C for Type III, Class 3, Style E equipment
Protection: ANSI C39.5 and IEC 348, Class I
Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.5 in x 8.5 in x 14.6 in)
Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)
Warranty Period: One year
Included: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide, and instrument performance record

Model

January 1986 prices

8840A Digital Multimeter	$ 760

Options

8840A-05 IEEE-488 Interface	150
8840A-05K Field Installable IEEE-488 Interface	170
8840A-09 True-RMS AC	185
8840A-09K Field Installable True-RMS AC	205

Accessories (Also see page 57)

Y8834 Single Rack Mount Kit	35
Y8835 Dual Rack Mount	75
Y8836 Center Rack Mount Kit	125
Y8021 1m IEEE-488 Shielded Cable	85
Y8022 2m IEEE-488 Shielded Cable	95
Y8023 4m IEEE-488 Shielded Cable	105
Y8077 Four Terminal Short	30
A90 6-Range Current Shunt	595

Also see page 230 for more accessory information.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

DIGITAL MULTIMETER

8840A/AF

Specifications

DC Voltage

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Resistance
		5½ Digits	4½ Digits*	
200 mV	199.999 mV	1 μV	10 μV	≥10,000 MΩ
2V	1.99999V	10 μV	100 μV	≥10,000 MΩ
20V	19.9999V	100 μV	1 mV	≥10,000 MΩ
200V	199.999V	1 mV	10 mV	10 MΩ
1000V	1000.00V	10 mV	100 mV	10 MΩ

*4½-digits at the fastest reading rate.

Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Range	24 Hour* 23°±1°C	90 Day 23°±5°C	1 Year 23°±5°C
200 mV**	0.003 + 3	0.007 + 4	0.008 + 4
2V	0.002 + 2	0.004 + 3	0.005 + 3
20V	0.002 + 2	0.005 + 3	0.006 + 3
200V	0.002 + 2	0.005 + 3	0.006 + 3
1000V	0.003 + 2	0.005 + 3	0.007 + 3

*Relative to calibration standards
**Using Offset control

Medium and Fast Rates: In medium rate, add 2 counts to number of counts. In fast rate, use 2 counts for the number of counts

Operating Characteristics

Temperature Coefficient: >±(0.0006% of Reading + 0.3 Count) per °C from 18°C to 0°C and 28°C to 50°C
Maximum Input: 1000V dc or peak ac on any range
Noise Rejection: Automatically optimized at power-up for 50, 60 or 400 Hz

Rate	Readings/ Second[1]	Filter	NMRR[2]	Peak NM Signal	CMRR[3]
S	2.5	Analog & Digital	>98 dB	20V or 2xFS[4]	>140 dB
M	20	Digital	>45 dB	1xFS	>100 dB
F	100	None	—	1xFS	>60 dB

[1] Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail
[2] Normal Mode Rejection Ratio, at 50 or 60 Hz ±0.1%. The NMRR for 400 Hz ±0.1% is 85 dB in S rate and 35 dB in M rate
[3] Common Mode Rejection Ratio at 50 or 60 Hz ±0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates
[4] 20 volts or 2 times Full Scale whichever is greater, not to exceed 1000V

DC Voltage Ratio

Input Characteristics

Range	Full Scale 5½ Digits	Input Voltage		Reference Voltage	
		Full Scale	Input Resistance	Range	Input Resistance
200m*	199.999m DC*	199.999mV dc	≥10,000 MΩ	From +1V dc to +19.9999V dc	≥10,000 MΩ
2	1.99999 DC	1.99999V dc	≥10,000 MΩ		
20	19.9999 DC	19.9999V dc	≥10,000 MΩ		
200	199.999 DC	199.999V dc	≥10 MΩ		
1000	1000.00 DC	1000V dc	≥10 MΩ		

*The "m" (milli) annunciator lights to indicate a 10^{-3} multiplier. Divide the displayed number by 1000 to obtain the actual ratio of the two voltages.

Accuracy:

±(Percentage of Reading + Number of Counts) for 1 year

Reference Voltage	Temperature	
	20°C to 30°C	0°C to 55°C
+10V <VREF <+20V	0.01 + 5	0.04 + 15
+1V ≤VREF ≤+10V	$(0.01 + 5) \times \frac{10V}{VREF}$	$(0.04 + 15) \times \frac{10V}{VREF}$

Operating Characteristics

Maximum Input: 1000V dc or rms ac on any range

Note: The INPUT LO terminal must be connected to the REFERENCE LO terminal. If these terminals are not connected together, inaccurate readings may result. These terminals are not connected together internally.

Reading Rates: Readings Per Second (With Internal Trigger)

Rate	Power Line Frequency		
	50 Hz	60 Hz	400 Hz
S	1	1.2	1.1
M	5.4	6.5	6.1
F	12.6	12.6	12.6

True-RMS AC Voltage

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		Input Impedance
		5½ Digits	4½ Digits*	
200 mV	199.999 mV	1 μV	10 μV	1 MΩ shunted by <100 pF
2V	1.99999V	10 μV	100 μV	
20V	19.9999V	100 μV	1 mV	
200V	199.999V	1 mV	10 mV	
1000V	1000.00V	10 mV	100 mV	

*4½-digits at the fastest reading rate.

Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)
For sinewave inputs ≥10,000 counts[1]

Frequency (Hz)	24 Hour[2] 23°±1°C	90 Day 23°±5°C	1 Year 23°±5°C
20-45	1.2 + 100	1.2 + 100	1.2 + 100
45-100	0.3 + 100	0.35 + 100	0.4 + 100
100-20k	0.07 + 100	0.14 + 100	0.16 + 100
20k-50k	0.15 + 120	0.19 + 150	0.21 + 200
50k-100k	0.4 + 300	0.5 + 300	0.5 + 400

[1] For sinewave inputs between 1,000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz
[2] Relative to calibration standards

Medium and Fast Reading Rates: In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 counts and >100 Hz

Operating Characteristics

Temperature Coefficient: ±(% of Reading + Number of Counts) per °C, 18°C to 0°C and 28°C to 50°C

For Inputs	Frequency in Hz		
	20-20k	20k-50k	50k-100k
≥10,000 counts	0.019 + 9	0.021 + 9	0.027 + 10
≥1,000 counts	0.019 + 12	0.021 + 15	0.027 + 21

Crest Factor

Nonsinusoidal Inputs: For nonsinusoidal inputs ≥10,000 counts with frequency components ≤ 100 kHz, and the following % of reading to the accuracy specifications

Fundamental Frequency	1.0 to 1.5	1.5 to 2.0	2.0 to 3.0
45 Hz to 20 kHz	0.05	0.15	0.3
20 Hz to 45 Hz and 20 kHz to 50 kHz	0.2	0.7	1.5

Maximum Input: 1000V rms, or 2 x 10^7 Volts-Hertz product (whichever is less) for any range
Common Mode Rejection: >60 dB at 50 or 60 Hz with 1 kΩ in either lead

Current

Input Characteristics

Range	Full Scale 5½ Digits	Resolution	
		5½ Digits	4½ Digits*
2000 mA	1999.99 mA	10 μA	100 μA

*4½-digits at the fastest reading rate

DC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)

Current	90 Days 23°±5°C	1 Year 23°±5°C
≤1A	0.04 + 4	0.05 + 4
>1A	0.1 + 4	0.1 + 4

Medium and Fast Reading Rates: In medium reading rate, add 2 counts to number of counts. In fast reading rate, use 2 counts for number of counts

AC Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)
1 Year, 23°±5°C, for sinewave inputs ≥10,000 counts

Frequency in Hertz		
20-45	45-100	100-5k*
2.0 + 200	0.5 + 200	0.4 + 200

*Typically 20 kHz

Medium and Fast Reading Rates: In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 counts and frequencies >100 Hz, the accuracy is ±(0.2% of reading + 30 counts)

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 18°C to 0°C and 28°C to 50°C
Maximum Input: 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse
Burden Voltage: 1V dc or rms ac typical at full scale

Resistance

Input Characteristics

Range	Full Scale 5½ Digits	Resolution		
		5½ Digits	4½ Digits*	Current Through Unknown
200Ω	199.999Ω	1 mΩ	10 mΩ	1 mA
2 kΩ	1.99999 kΩ	10 mΩ	100 mΩ	1 mA
20 kΩ	19.9999 kΩ	100 mΩ	1 Ω	100 μA
200 kΩ	199.999 kΩ	1Ω	10Ω	10 μA
2000 kΩ	1999.99 kΩ	10Ω	100Ω	5 μA
20 MΩ	19.9999 MΩ	100Ω	1 kΩ	0.5 μA

*4½-digits at the fastest reading rate.

Accuracy

Normal (S) Reading Rate: ±(% of Reading + Number of Counts)[1]

Range	24 Hour[2] 23°±1°C	90 Day 23°±5°C	1 Year 23°±5°C
200Ω	0.004 + 3	0.011 + 4	0.014 + 4
2 kΩ	0.0028 + 2	0.01 + 3	0.013 + 3
20 kΩ	0.0028 + 2	0.01 + 3	0.013 + 3
200 kΩ	0.0028 + 2	0.01 + 3	0.013 + 3
2000 kΩ	0.023 + 3	0.027 + 3	0.028 + 3
20 MΩ	0.023 + 3	0.043 + 4	0.044 + 4

[1] *Using Offset control*
[2] *Relative to calibration standards*

Medium and Fast Reading Rates: In medium rate, add to the number of counts 2 counts for the 200Ω through 200 kΩ ranges and 3 counts for the 2000 kΩ and 20 MΩ ranges. In fast reading rate, use for the number of counts 3 counts for the 200Ω range, and 2 counts for all other ranges.

Operating Characteristics

Temperature Coefficient: Less than 0.1 x accuracy specification per °C from 18°C to 0°C and 28°C to 50°C
Measurement Configuration: 2-wire or 4-wire
Open Circuit Voltage: Less than 6.5V on the 200Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges
Input Protection: To 300V rms

Reading Rates

Reading Rates With Internal Trigger (readings per second):

Rate	Power Line Frequency*		
	50 Hz	60 Hz	400 Hz
S	2.08	2.5	2.38
M	16.7	20	19.0
F	100	100	100

*Sensed automatically at power-up

General Specifications

IEEE-488 Interface Function: Option allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0
Common Mode Voltage: 1000V dc or rms ac from any input to earth ground
Temperature Range: 0°C to 55°C operating; -62°C to +85°C storage
Humidity Range: 95% RH, +5% -0%
EMI: Complies with CE01 (relaxed 20 dB), CE03 (relaxed 10 dB), CS01, CS02, CS06, and RE02 (relaxed 10 dB) as specified in MIL-STD-461
Altitude: 4,500m (15,000 ft) operating; 12,000m (40,000 ft) non-operating
Warmup Time: 1 hour to rated specifications
Power: 100, 120, 220, or 240V ac ±10% (250V ac maximum), switch selectable at rear panel; 50, 60, or 400 Hz, automatically sensed at power up; 20 VA maximum
Vibration: Meets requirements of MIL-T-28800C for Type II, Class 3, Style B equipment
Size: 8.9 cm H x 21.6 cm W x 37.1 cm D (3.47 in x 8.5 in x 14.6 in)
Weight: Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)
Included: Line cord, test leads, Instruction/Service Manual, IEEE-488 Quick Reference Guide (with Option -05 only), and instrument performance record

Model

January 1986 prices

8840A/AF Digital Multimeter .... (NSN 6625-01-196-0014)	$1100

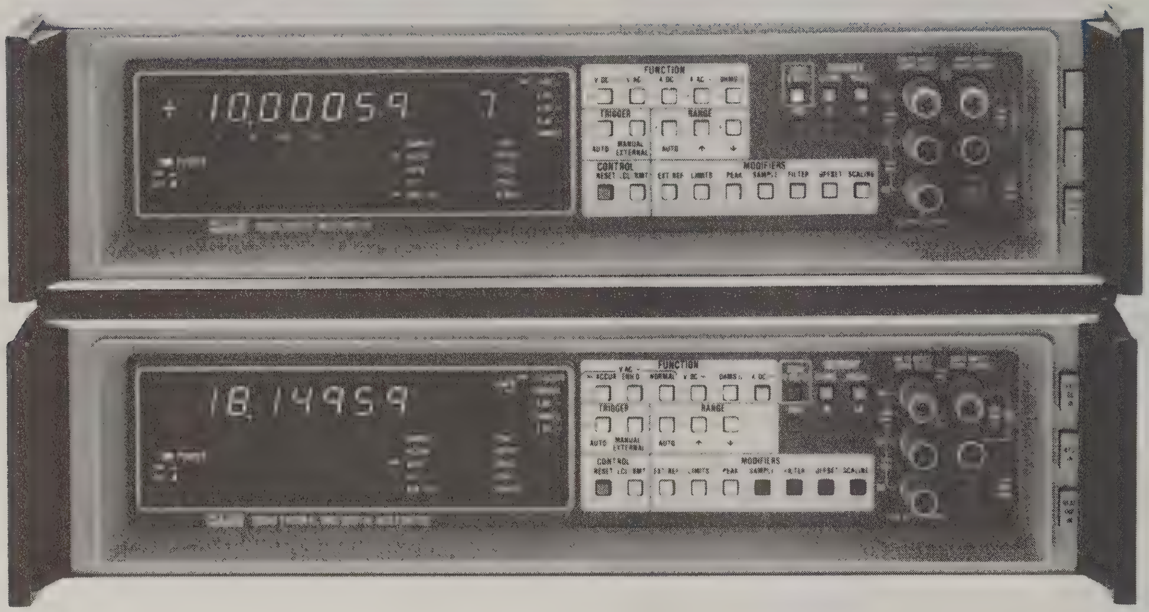
Options

8840A-05 IEEE-488 Interface	150
8840A-05K Field Installable IEEE-488 Interface	170

Accessories And After-Warranty Service (See 8840A)

DIGITAL MULTIMETERS

8506A/8505A



8506A/8505A

8506A Thermal RMS Digital Multimeter

- 8505A features plus
- 120 ppm ac accuracy, 40 Hz to 20 kHz
- Full accuracy for crest factors as high as 8:1
- 25 ppm short-term ac stability
- Frequency response specified to 1 MHz
- AC-DC transfer accuracies with DMM speed and convenience

8505A Digital Multimeter

- 5 ppm dc accuracy, 100 nV (nanovolt) sensitivity
- 500 readings per second with 6½-digit resolution
- AC (8505A only), ohms, current module options
- IEEE-488, RS-232-C, and parallel interfaces
- Front-rear switchable input standard in basic mainframe
- Software calibration from front panel or remote interface
- Modular construction for application flexibility

The 8505A and 8506A Digital Multimeters are Fluke's most advanced bench/system DMMs. Both models excel in dc accuracy, resolution, versatility and speed.

The 8506A uses a fast thermal rms sensing technique for measuring ac which very significantly advances the state-of-the-art for ac measurements using a system DMM: It is several times more accurate than the calculating type of true-rms converter and is unmatched by any other DMM. Basic ac accuracy uncertainty is reduced to 120 parts per million for frequencies from 40 Hz to 20 kHz. That approximates the accuracy you can expect using traditional thermal transfer techniques that typically take several minutes for each measurement. Short term stability is 25 ppm. Accuracy is specified from 10 Hz to 1 MHz and non-sinusoidal waveforms having crest factors as high as 8 to 1 can be measured with full 90-day accuracy.

Software Calibration

Both the 8506A and 8505A have a "software calibration" feature that makes it easy to store correction factors for every range of any measurement function. You can update the 24-hour accuracy specifications daily, or whenever the need arises — without having to remove the covers. Nor do you need to use a cardinal point standard for a reference. Any reference having a suitably accurate value between 60% of range and full scale will do. This "software calibration" is managed with a few keystrokes on the front panel or even remotely when used as part of a test and measurement system.

Measurement Speed

Most system DMM manufacturers use an integrating technique for A-to-D conversion. That means there must be a compromise between resolution and reading speed. The 8505A and 8506A use a Fluke patented "recirculating remainder" technique for A-to-D conversion that does not compromise 6½-digit resolution at reading speeds up to 500 per second. Front or rear measurement inputs are switch-selectable from the front panel. For system applications the position of the switch can be sensed through the interface. An external trigger input is included to control the timing of measurements remotely. And, to control the switching time of an external scanner, scanner-advance output pulses are available at the rear panel.

Either IEEE-488, RS-232-C, or one of several parallel interface options may be used for systems applications. The parallel interfaces will work with DEC computer interfaces DR11C, DRV11, or PC11 or with HP computer interfaces 12566 or HP98032A.

Math Power

The 8506A and 8505A are controlled by an internal microprocessor and have built in math power to add, subtract, multiply, and divide as well as store and compare numerical information. Each measurement may be made a part of a calculation before being displayed or recorded. Stored HI and/or LO limit values may be repeatedly compared to measured values to determine out-of-tolerance conditions. HI, LO, or PASS indications may appear directly in the display. The highest and lowest values in a series of measurements may be stored and later displayed. And measurements may all be in terms of ± deviations from a stored "offset" value. In general, any calculation is possible based on the general formula.

$$Y = mx+b$$

Where m = scaling factor (multiplier),
x = value measured,
b = the ± offset, and
Y = the numerical result

8506A & 8505A Differences

The 8505A is Fluke's lowest cost DMM having top dc accuracy, resolution, and speed. Two options for measuring ac voltage are available — either an ac average-sensing, rms-indicating option (-01) for sinewaves or an ac true-rms option (-09A) for either sinewaves or non-sinusoidal waveforms. An option for measuring current (-03) and an option for measuring resistance (-02A) are also available for the 8505A. For measuring ac current, an ac voltage option (-01 or -09A) must also be installed. An 8505A, when fully equipped, will measure dc and ac voltage, dc and ac current, and resistance. The 8506A and 8505A have identical dc measurement capabilities but the 8506A requires no option for measuring ac voltage. State-of-the-art ac voltage measurement capabilities are built in. An option for measuring dc current may be installed (-03) or an option for measuring resistance may be installed (-02A), but not both at the same time. Any external dc reference voltage up to 40 volts that is applied at the rear panel may be compared and the relative values displayed as a ratio. The same interface options are available for the 8506A as for the 8505A.

8506A Specifications

DC Voltage

All dc voltage accuracy and stability specifications apply after a two-hour warm-up unless otherwise noted. The 24-hour specifications are relative to the calibration standards used.

Input Characteristics

Range	Full Scale (6½ Digits)	Resolution		Input Resistance
		7½* Digits	6½ Digits	
100 mV	200.0000 mV	—	100 nV	⩾10,000 MΩ
1V	2.000000V	—	1 μV	⩾10,000 MΩ
10V	20.00000V	1 μV	10 μV	⩾10,000 MΩ
100V	128.0000V	—	100 μV	10 MΩ
1000V	1200.000V	—	1 mV	10 MΩ

In AVG operating mode

Accuracy, Normal Mode, 6½ Digits: ±(% of Rdg + Counts)

Range	24 Hours* 23°C ±1°C	Long Term, 18°C to 28°C	
		Up to 90 Days	Add per Month Over 90 Days
100 mV	0.0018 + 15	0.0025 + 40	0.00017 + 5.6
1V	0.0008 + 7	0.0015 + 8	0.0001 + 0.1
10V	0.0006 or 6**	0.0010 + 8	0.0001 + 0.1
100V	0.0010 + 6	0.0018 + 8	0.00013 + 0.1
1000V	0.0008 + 6	0.0018 + 8	0.00013 + 0.1

**After 4-hour warm-up and within 1 hour of zeroing dc*
***Whichever is greater*

Accuracy, AVG Mode, 6½ Digits: ±(% of Rdg + Counts)

Range	24 Hours* 23°C ±1°C	Long Term, 18°C to 28°C	
		Up to 90 Days	Add per Month Over 90 Days
100 mV	0.0010 + 8	0.0020 + 8	0.0001 + 0.1
1V	0.0005 + 4	0.0012 + 6	0.0001 + 1
10V**	0.0005 or 50***	0.0008 + 60**	0.00008 + 1**
100V	0.0005 + 5	0.0015 + 6	0.0001 + 0.1
1000V	0.0005 + 5	0.0015 + 6	0.0001 + 0.1

**After 4-hour warm-up and within 1 hour of zeroing dc*
***7½-digit mode of operation*
****Whichever is greater*

Accuracy, Software Calibration

Fully restores above "24-hour" accuracy for 24 hours each time performed within 30 days after hardware calibration is performed. After 30 days add the following number of counts to the 24-hour accuracy specifications.

Time Since Internal (Hardware) Calibration	Number of Counts to be Added	
	6½ Digits	7½ Digits
Less than 30 Days	0	0
30 to 90 Days	1	10
90 Days to 1 Year	2	20
More than 1 Year	3	30

Temperature Coefficient: ±(% of Rdg + Counts)/°C

Range	18°C to 0°C and 28°C to 50°C	
	6½ Digits	7½ Digits
100 mV	0.0003 + 5	0.0003 + 50
1V	0.0003 + 1	0.0003 + 10
10V	0.0002 + 0.5	0.0002 + 5
100V	0.0003 + 1	0.0003 + 10
1000V	0.0003 + 0.5	0.0003 + 5

Input Bias Current

At time of Adjustment	1 Year 23°C ±1°C	Temperature Coefficient
<±5 pA	<±30 pA	<±1 pA/°C

Zero Stability: Less than 5 μV for 90 days after a four hour warm-up. Front panel pushbutton zero is provided for permanent storage of a zero correction for each range. Zero may be turned off at any time.

Normal Mode Rejection

Line Frequency	Filter Mode	4 Samples Per Reading	32 Samples Per Reading	128 Samples Per Reading
50 Hz	Fast	60 dB	70 dB	75 dB
50 Hz	Slow	85 dB	90 dB	95 dB
60 Hz	Fast	60 dB	70 dB	75 dB
60 Hz	Slow	90 dB	95 dB	100 dB

Common Mode Rejection: 160 dB at 60 Hz with 1 kΩ in series with either lead, and 4 samples or more per reading. Greater than or equal to 100 dB with less than 4 samples per reading.

Analog Settling Time

Filter Mode	Filter Command	To 0.01% of Step Change	To 0.001% of Step Change
Bypassed	F1	2 ms	20 ms
Fast	F0 or F3	40 ms	50 ms
Slow	F or F2	400 ms	500 ms

Digitizing Time (Line Synchronous): For 2^0 to 2^{17} samples per reading the digitizing time is from 4 ms to 9 minutes 6 seconds using a 60 Hz line. Time increases 20% using 50 Hz ac line. Selectable in 18 binary steps.
Digitizing Time (Line Asynchronous): 2 ms in 3-byte binary mode with dc zero, offset, limits and calibration factors turned off
Maximum Input: ±1200V dc or 1000V rms ac to 60 Hz, or 1400V peak above 60 Hz may be applied continuously to any dc range without permanent damage. Maximum rate of voltage change is 1000V per μs.

Ratio (External DC Reference)

Voltage, resistance, or current may be measured and compared to an external dc voltage and displayed as a ratio. Option -02A or -03 is required when measuring resistance or current. The dc reference voltage (V_{xref}) is applied to terminals on the back panel and is the denominator of the ratio.

Input Resistance: >10,000 MΩ between Ext Ref HI and LO and between either Ext Ref HI or LO and Ohms Guard or Sense LO
Max. Reference Voltage: ±40V between Ext Ref HI and LO terminals providing neither terminal is greater than ±20V relative to the Sense LO or Ohms Guard terminal
Min. Reference Voltage: ⩾0.0001V when comparing voltage or current, and ⩾0.0001V or 1 billionth of the absolute value of resistance, whichever is greater, when comparing resistance
Maximum Ratio Display: 10^{-9} to 10^9
Source Impedance: Resistive unbalance (Ext Ref HI to LO) <4 kΩ. Total resistance to Sense LO from either Ext Ref HI or LO <20 kΩ
Overload Voltage: ±180V dc or peak ac relative to Ohms Guard or Sense LO. ±360V dc or peak ac (Ext Ref HI to LO)
Normal Mode Noise Rejection: ⩾100 dB for line frequency and 2x line frequency
Common Mode Noise Rejection: ⩾75 dB for dc, line frequency, and 2x line frequency

Ratio Accuracy

External Reference Voltage	Accuracy
±20V to ±40V	$\pm(A + B + 0.001\%)$
$\pm V_{min}$ to ±20V	$\pm(A + B + (0.02\% \div \lvert V_{xref} \rvert))$

A = 10V dc range accuracy for the appropriate period of time
B = Input signal function and range accuracy for the appropriate period of time
V_{min} = Minimum allowable external reference voltage
$\lvert V_{xref} \rvert$ = Absolute value of the external reference voltage

Digitizing Time: 196 ms to 9 minutes and 6s for 2° to 2^{17} samples per reading using 60 Hz line, increasing 20% using 50 Hz line.

AC Voltage (Thermal RMS)

All ac voltage accuracy and stability specifications for 5½-digit displays using at least 25% of full scale after a 2-hour warm-up. Except where noted, ac coupling is used to block dc. The 24-hour specifications are relative to the calibration standards used and within 1 hour of dc zero.

Input Characteristics

Range	Full Scale (5½ Digits)	Resolution 6½ Digits*	Resolution 5½ Digits	Input Impedance
100 mV	125.000 mV	—	1 μV	1 MΩ ±1% shunted by <180 pF
300 mV	400.000 mV	—	1 μV	
1V	1.25000V	1 μV	10 μV	
3V	4.00000V	1 μV	10 μV	
10V	12.5000V	10 μV	100 μV	
30V	40.0000V	10 μV	100 μV	
100V	125.000V	100 μV	1 mV	
500V	600.000V	100 μV	1 mV	

**In AVG operating mode*

Settling Time

High Accuracy Mode: Sample time is 3.5 seconds, hold time is 2.5 seconds. Measurement time is 6 seconds — the sum of sample time and hold time. If the state of the instrument is unknown, two complete measurement cycles will be required to guarantee a correct reading. Use of an external trigger will allow a 6-second measurement cycle.
Enhanced Mode: The first reading requires the same time as the high accuracy mode. Subsequent readings occur every 500 milliseconds. If the input changes 0.1% the analog settling time to 90-day mid-band accuracy is 1.5 seconds.
Normal Mode: Settling time for large changes is non-linear. Zero to full scale changes require 2.0 seconds to settle to 90-day, mid-band specifications. Full scale to 10% of full scale changes require 3.0 seconds to settle to mid-band, 90-day specifications. Small changes (<1%) settle to mid-band specifications in <1.5 seconds.
Autoranging: Upranges when input is higher than full scale. Downranges when reading is less than approximately 28% of full scale.

Accuracy, High-Accuracy Mode: ±(% of Reading)

24 Hours, 23°C ±1°C

Ranges	Frequency in Hertz 10** to 40	40 to 20k	20k to 50k	50k to 100k	100k to 200k	200k to 500k	500k to 1M
100 mV	0.08	0.02*	0.04*	0.2	0.6	1.5	3.5
300 mV to 10V	0.08	0.012	0.04	0.2	0.5	1.5	3.5
30V	0.08	0.012	0.05	0.2	0.5	3.5	12
100V	0.08	0.012	0.04	0.2	1.0	3.5	—
500V	0.08	0.012	0.04	0.2	—	—	—

90 Days, 18°C to 28°C

100 mV	0.08	0.026*	0.06	0.2	0.6	1.5	3.5
300 mV to 10V	0.08	0.016	0.06	0.2	0.5	1.5	3.5
30V	0.08	0.016	0.06	0.2	0.5	3.5	12
100V	0.08	0.016	0.06	0.2	1.0	3.5	—
500V	0.08	0.016	0.06	0.2	—	—	—

>90 Days, 18°C to 28°C, per month. Add to the 90-day specification the following % of reading.

All	0.008	0.0001	0.0025	0.012	0.021	0.06	0.11

**Add 5 digits (5 μV) to the % of reading*
***With Slow filter*

Accuracy, Enhanced Mode: Add the following (% of reading + number of digits) to the accuracy specifications of the high accuracy mode —

Ranges	Time Since First Reading	
	<5 Min	>5 and <30 Min
All except 500V	0 + 0	0.003 + 4
500V	0 + 0	0.003 + 6

Accuracy, Normal Mode: Add the following % of reading to the accuracy mode specification of the high accuracy mode —

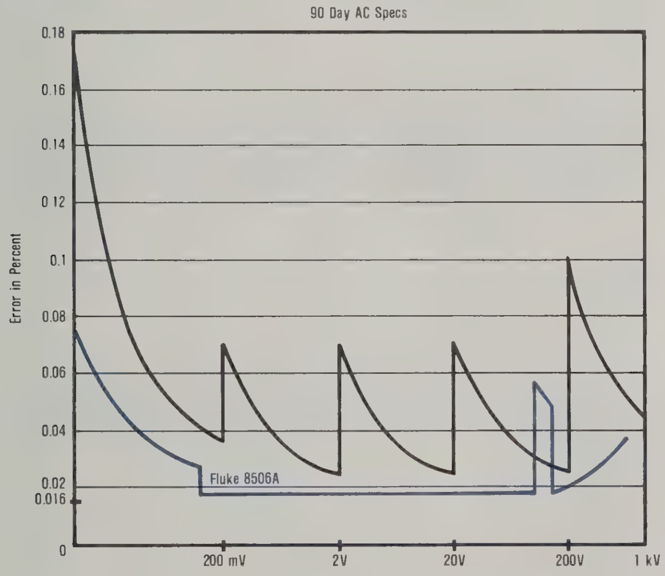
Segment of Scale	24 Hour, 90 Day	>90 Day Add per Month
0.25 x to 1 x full scale	0.4	0.044
0.1 x to 0.25 x full scale	0.6	0.055

Stability: 40 Hz to 20 kHz, <1°C Temperature Change

Range	±(% of Rdg + Counts)*	
	24 Hours	90 Days
100 mV, 1V, 10V, 100V	0.0025 + 1	0.004 + 1
300 mV, 3V, 30V	0.0025 + 3	0.004 + 4
500V	0.0025 + 5	0.004 + 6

For 5½-digit resolution

Crest Factor: Up to 8:1, with 90-day or greater accuracy for input signals with peaks less than two times full scale and high frequency components within the 3 dB bandwidth. Up to 4:1 for signals with peaks less than four times full scale, with the addition of 0.03 to the percent-of-reading specification.
3 dB Bandwidth (Typical): 3 MHz for the 100 mV range and 10 MHz for the 300 mV, 1V, 3V and 10V ranges
Maximum Input Voltage: ±600V dc or rms ac, 840V peak, or 1x10^7 volt-hertz product
DC-Coupled (AC+DC) Accuracy: ±(1.1 times the appropriate ac-coupled specifications + a calculated "Adder" from the following table) —



This graph compares the total ac uncertainty of the 8506A's thermal rms converter to that of a typical computing rms converter used in other DMMs. The effects of floor error which cause large uncertainties at the beginning of each range are non-existent in the 8506A from 125 mV ac to 125V ac.

Range	Adder
100 mV to 1V	±(150 μV x (dc volts/total rms volts))
3V and 10V	±(1 mV x (dc volts/total rms volts))
30V and 100V	±(10 mV x (dc volts/total rms volts))
500V	±(50 mV x (dc volts/total rms volts))

Temperature Coefficient: One tenth of the 90-day accuracy specification per °C from 18°C to 0°C or 28°C to 50°C
Common Mode Rejection: >120 dB from dc to 60 Hz with 100Ω in series with either lead

8506A Option Specifications

Resistance Option (-02A)

All resistance accuracy and stability specifications apply after a 2-hour warm-up. The 24-hour specifications are relative to the calibration standards used.

Input Characteristics

Range	Full Scale (5½ Digits)	Resolution*		Current Through Unknown
		6½ Digits	5½ Digits	
10Ω	20.0000Ω	10 μΩ	100 μΩ	10 mA
100Ω	200.000Ω	100 μΩ	6½ Digits Only	10 mA
1 kΩ	2.00000 kΩ	1 mΩ		1 mA
10 kΩ	25.0000 kΩ	10 mΩ		78 μA
100 kΩ	250.000 kΩ	100 mΩ		7.2 μA
1 MΩ	4.10000 MΩ	1Ω	10Ω	4.5 μA
10 MΩ	35.0000 MΩ	10Ω	100Ω	0.45 μA
100 MΩ	265.000 MΩ	100Ω	1 kΩ	56 nA

* *In normal operating mode, 5½ or 6½ digits depending on range. In AVG operating mode, 6½ digits on all ranges.*

Open Circuit Voltage. 7V maximum from 10Ω through 100k range; 25V maximum from 1 MΩ range through 100 MΩ range
Maximum Input: ±400V dc or peak ac, continuous on any range with no damage
Analog Settling Time: 80 ms with Fast filter or 800 ms with Slow filter, to rated accuracy
Digitizing Time: Depending on sample rate and filter selection the digitizing time will vary from 145 ms to 9 minutes 6 seconds using a 60 Hz ac line. Time increases 20% using a 50 Hz line.

Accuracy, 5½ Digits: ±(% of Rdg + Counts)**

Range	24 Hours 23°C ±1°C	Long Term, 18°C to 28°C		Plus Temp Coefficient Per °C*
		Up to 90 Days	>90 Days Add to % of Rdg	
10Ω	0.003+20	0.005+20	0.00056	0.0008+1.5
100Ω	0.002+1.4	0.003+1.4	0.00033	0.0007+0.2
1 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.2
10 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.2
100 kΩ	0.002+0.8	0.003+0.8	0.00033	0.0007+0.5
1 MΩ	0.002+0.8	0.003+0.8	0.00033	0.001+0.5
10 MΩ	0.0075+0.8	0.02+0.8	0.0022	0.005+0.5
100 MΩ	0.026+0.8	0.05+1	0.0056	0.02+0.5

From 18°C to 0°C or 28°C to 50°C
For 6½-digit display, multiply number of counts by 10

Measurement Configuration: Two-wire and four-wire available on all ranges
Four-Wire Lead Resistance: Source leads should not exceed 10Ω for the 10Ω and 100Ω ranges, 100Ω for the 1 kΩ range, or 1 kΩ for the 10 kΩ or higher ranges

DC Current Option (-03)

All current accuracy and stability specifications apply after a 2-hour warm-up. The 24-hour specifications are relative to the calibration standards used. No ac current option is available for the 8506A.

Input Characteristics

Range	Full Scale (5½ Digits)	Resolution 6½* Digits	Resolution 5½ Digits	Voltage Burden
100 μA	250.000 μA	0.1 nA	1 nA	≤100 mV
1 mA	2.00000 mA	1 nA	10 nA	≤100 mV
10 mA	16.0000 mA	10 nA	100 nA	≤200 mV
100 mA	128.000 mA	100 nA	1 μA	≤200 mV
1A	1.28000A	1 μA	10 μA	≤500 mV

**In AVG operating mode*

Accuracy, 5½ Digits: ±(% of Rdg + Counts)**

Range	24 Hours 23°C ±1°C	Long Term, 18°C to 28°C Up to 90 Days	Long Term, 18°C to 28°C >90 Days Add to % of Rdg	Plus Temp Coefficient Per °C*
100 μA	0.02+10	0.03+10	0.0022	0.0025+0.6
1 μA	0.02+10	0.03+10	0.0022	0.0025+0.6
10 mA	0.02+10	0.03+10	0.0022	0.0025+0.6
100 μA	0.03+20	0.05+20	0.0056	0.0035+0.6
1A	0.03+20	0.05+20	0.0056	0.0035+0.6

**From 18°C to 0°C or 28°C to 50°C*
***For 6½-digit display, multiply number of counts by 10*

Overload: 1.5A maximum, ±140V dc or peak ac to 60 Hz, or 200V peak ac above 60 Hz on any range with no damage. Protected by a 1.5A fuse.
Settling and Digitizing Time: Same as for dc volts

IEEE-488 Interface Option (-05)

This interface incorporates the following subset of the IEEE Standard 488-1978; SH1, AH1, T5, L4, SR1, RL2, DC1, DT1, and E1. The interface allows full control of all instrument functions and the transfer of ASCII or binary data. In the binary mode the instrument is capable of 500 readings per second.

RS-232 Interface Option (-06)

This interface is a bit serial asynchronous interface providing either voltage or 20 mA current loop level signals. The interface allows selection of baud rate from 50 to 9600, either one or two stop bits, and odd or even parity. Up to 40 ASCII character readings per second are possible with Option -06.

Bit-Parallel Interface Options (-07A,-07B,-07D,-07H,-07L)

Permit you to connect the instrument to a large variety of minicomputer and microcomputer interfaces. This is accomplished via a plug-in header called a "personality card" that you may wire to your system or that may be supplied in standard versions by Fluke. Personality cards are available for three DEC PDP 11 interfaces (DRIIC, DRVII and PC11) and for two HP interfaces (HP 12566 and HP 98032A). The interface permits either 8- or 16-bit parallel ASCII transfers or 8- or 16-bit parallel binary transfers. In the binary mode the instrument is capable of up to 500 readings per second.

8505A Specifications

DC Voltage

Same specifications as for 8506A

Ratio (External DC Reference)

Same specifications as for 8506A for dc ratio. AC/AC ratio available upon special request

8505A Option Specifications

True-RMS AC Voltage Option (-09A)

All true-rms ac voltage accuracy and stability specifications apply to readings between 0.1% of range to full scale after a 2-hour warm-up. Options -09A and -01 may not be installed at the same time.

Accuracy: ±(% of Rdg + % of Full Scale)*

Frequency	90 Days, 18°C to 28°C % of Rdg	90 Days, 18°C to 28°C % Full Scale (AC)	90 Days, 18°C to 28°C % Full Scale (AC + DC)
DC	0.1	—	0.03
10 Hz to 20 Hz	1.0	0.04	0.06
20 Hz to 50 Hz	0.5	0.012	0.03
50 Hz to 10 kHz	0.1	0.012	0.03
10 kHz to 30 kHz	0.2	0.04	0.06
30 kHz to 50 kHz	0.3	0.1	0.12
50 kHz to 100 kHz	1.0	0.3	0.3
100 kHz to 300 kHz	2.0	0.5	0.5
300 kHz to 1 MHz	3.3	1.8	1.8

** Slow filter must be used below 400 Hz. For inputs greater than 500V multiply the accuracy specification by: (2000 + reading) ÷ 2000*

Common Mode Rejection: >120 dB, dc to 60 Hz, with 100Ω unbalance in either lead
Crest Factor: >7 at full scale, increasing down scale by
$7x \sqrt{V_{Range} \div V_{Reading}}$
Voltage & Frequency Limits: 1x10^7 volt-hertz product for the 1V and 10V ranges and 2x10^7 for the 100V and 1000V ranges
Analog Settling Time: 100 ms with Fast filter and 500 ms with Slow filter to within 0.1% of a step change within a range
Digitizing Time: Same as for dc voltages. See 8506A specifications

Average-Sensing AC Voltage Option (-01)

All average-sensing ac voltage accuracy and stability specifications apply to a 5½-digit display with readings between 0.1% of range to full scale after a 2-hour warm-up. Option -01 and -09A may not be installed at the same time.

Input Characteristics

Range	Full Scale (5½ Digits)	Resolution 6½ Digits*	Resolution 5½ Digits	Input Impedance
1V	2.50000	1 μV	10 μV	1 MΩ
10V	20.0000	10 μV	100 μV	shunted
100V	160.000	100 μV	1 mV	by
1000V	1000.00	1 mV	10 mV	<100 pF

**In AVG operating mode*

Accuracy: ±(% of Rdg + Counts)*

Frequency	90 Days, 18°C to 28°C 1 mV to 500V**	90 Days, 18°C to 28°C Above 500V
30 Hz to 50 Hz	0.5 + 5	0.55 + 5
50 Hz to 10 kHz	0.05 + 5	0.1 + 5
10 kHz to 40 kHz	—	0.15 + 5
10 kHz to 50 kHz**	0.1 + 5	—
50 kHz to 100 kHz**	0.5 + 5	—

** Slow filter must be used below 400 Hz. For 6½-digit display, multiply number of counts by 10*
*** On 1-volt range add 7 counts above 10 kHz or 35 counts above 50 kHz*

Common Mode Rejection: >120 dB, dc to 60 Hz with 100Ω imbalance in either lead
Voltage and Frequency Limits: 1000V rms (1400V peak) or 2x10^7 volt-hertz product, whichever is less
Analog Settling Time: 100 ms with Fast filter and 500 ms with Slow filter, to within 0.05% of step change within a range
Digitizing Time: Same as for dc voltages. See 8506A specifications

Resistance Option (-02A)

Same specifications as for 8506A

DC and AC Current Option (-03)

All accuracy and stability specifications apply after a 2-hour warm-up.
Input Characteristics: Same as for 8506A
DC Current Accuracy: Same as for 8506A

AC Current Accuracy: ±(% of Rdg + Counts)*

Range	Frequency	90 Days, 23°C ±5°C	
		Option -01	Option -09A
100 μA	10 Hz-20 Hz	—	1.0 + 110
	20 Hz-50 Hz	0.8 + 9	0.8 + 35
	50 Hz-10 kHz	0.4 + 9	0.4 + 35
	10 kHz-20 kHz	0.7 + 9	1.0 + 110
	20 kHz-50 kHz	1.5 + 9	1.5 + 260
	50 kHz-100 kHz	3.0 + 9	4.0 + 760
1 mA and 10 mA	10 Hz-20 Hz	—	1.0 + 110
	20 Hz-50 Hz	0.5 + 9	0.5 + 35
	50 Hz-10 kHz	0.06 + 9	0.11 + 35
	10 kHz-20 kHz	0.11 + 9	0.2 + 110
	20 kHz-50 kHz	0.12 + 9	0.3 + 260
	50 kHz-100 kHz	0.51 + 9	1.0 + 760
100 mA	10 Hz-20 Hz	—	1.0 + 150
	20 Hz-50 Hz	0.5 + 55	0.5 + 80
	50 Hz-10 kHz	—	0.26 + 80
	50 Hz-100 kHz	0.24 + 55	—
1A	10 Hz-20 Hz	—	1.0 + 160
	20 Hz-50 Hz	0.5 + 65	0.5 + 90
	50 Hz-10 kHz	0.24 + 65	0.26 + 90

* *With 5½ digit display. For 6½-digit display, multiply number of counts by 10. AC Voltage Option -01 or -09A must also be installed to measure ac current*

Crest Factor: (Using Option -09A) >4.5 at full scale, increasing down scale by

$4.5 \times \sqrt{I_{Range} \div I_{Reading}}$

Maximum Overload: 1.5A maximum, ±140V dc or peak ac to 60 Hz, or 200V peak ac above 60 Hz on any range with no damage. Protected by a 1.5A fuse
Settling and Digitizing Time: Same as dc volts

IEEE-488 Interface Option (-05)

Same specifications as for 8506A

RS-232 Interface Option (-06)

Same specifications as for 8506A

Bit-Parallel Interface Option (-07)

Same specifications as for 8506A

General Specifications, 8506A & 8505A

Maximum Terminal Voltage:
LO to Guard, 127V rms
Guard to Chassis, 500V rms
HI Sense to HI Source, 127V rms
LO Sense to LO Source, 127V rms
HI Sense to LO Sense, 1000V rms or 1200V dc
HI Source to LO Source, 280V rms

Trigger Input: TTL level, ±30V maximum, factory wired for falling edge; may be rewired for rising edge. Pulse width ⩾10 μs
Scanner Advance Pulse: TTL level, ⩾3 μs width
Shock & Vibration: Meets requirements of MIL-T-28800C for Type III, Class 5, Style E equipment
Temperature: 0°C to 50°C, operating; -40°C to 70°C, non-operating
Relative Humidity: ⩽80% 0°C to 18°C, ⩽75% to 40°C, ⩽45% to 50°C
Size: 10.8 cm H x 43.2 cm W x 42.5 cm D (4.25 in x 17 in x 16.75 in)
Weight: 10 kg (22 lb) basic, 12 kg (26 lb) fully loaded
Included: Manual, power cord, serialized and dated calibration certification sheet
Power: 100, 120, 220, or 240 volt, 47-63 Hz, switch selectable

Models

	January 1986 prices
8506A Thermal RMS Digital Multimeter	$6430
8505A Digital Multimeter	3355

Options for 8506A & 8505A**

8505A-02A* Ohms Converter	510
8500A-03* Current Converter	510
8500A-05 IEEE-488 Interface	530
8500A-06 RS-232-C Interface	530
8500A-07A Parallel Interface (for DEC PDP11, DRIIC or DRVII)	530
8500A-07B Parallel Interface (for DEC PDP11, PC11)	530
8500A-07D Parallel Interface (general purpose)	530
8500A-07H Parallel Interface (for HP12566 or 98032A)	530
8500A-07L Parallel Interface, low noise (for DEC PDP11, DRIIC, or DRVII)	530

**Cannot install both -02A and -03 in 8506A at the same time*
***All options are customer installable*

Options for 8505A only

8500A-01* AC Converter (Average)	615
8500A-09A* AC Converter (True-RMS)	670

**Cannot install both -01 and -09A in 8505A at the same time*

Accessories (Also see page 57)

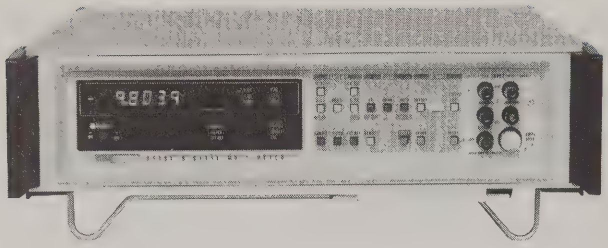
MIS-7011K Extender Card	135
MIS-7013K Bus Interconnect and Monitor	45
MIS-7190K Static Test Controller	285
MIS-7191K Test Module	475
M00-260-610 18″ Rack Slide Kit (rack adapter required)	105
M00-280-610 24″ Rack Slide Kit (rack adapter required)	110
M04-205-600 5¼″ Rack Adapter	95
Y8021 1m, IEEE-488 Shielded Cable	85
Y8022 2m, IEEE-488 Shielded Cable	95
Y8023 4m, IEEE-488 Shielded Cable	105
Y8133 Universal Test Leads	20
Y8140 Slim Test Leads	18
Y8077 Four Terminal Short	30

Also see page 230 for more accessory information.

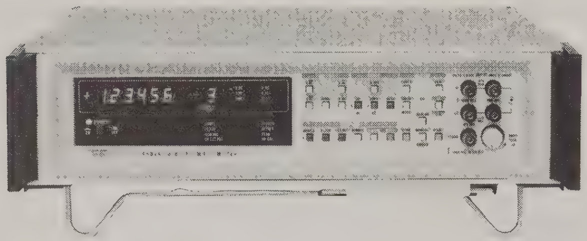
After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

8500A/8502A



8500A



8502A

8500A/8502A Digital Multimeters

- 6 ppm dc accuracy
- 6½-digit resolution
- 500 readings per second system speed
- Modular construction for configurability
- Interface options:
  IEEE-488, RS-232-C, or Parallel
- Measurement options:
  AC volts, true-rms or averaging
  Resistance
  Current
- Up to 212% overrange

The 8500A and 8502A Digital Multimeters are very similar. When used in a system under the control of a computer or an instrument controller, the performance of the 8500A and 8502A are practically identical. But the 8500A is primarily for use in a system so does not have as many front panel controls as the 8502A. For example, you can't enter digits from the front panel to be stored and used as a scaling factor, limit, etc. With the 8502A, every measurement that may be controlled remotely may also be controlled from the front panel, making the 8502A as capable on the bench as in a system.

Circuit Card Modules

The basic 8500A and 8502A measures dc voltage or the ratio of two dc voltages. With optional plug-in circuit card modules it will also measure resistance, ac or dc current, ac voltage, or the ratio of such a quantity to an external dc voltage.

One option is for resistance, one is for current, and two are for ac voltage — either true-rms for sinusoidal or non-sinusoidal waveforms, or average-sensing for sinewaves. The current-measuring option is good for both dc and ac current but one of the ac voltage measurements options must also be installed. All the measurement capabilities may be included in one instrument if you wish, except that only the true-rms or the average-sensing measurement module can be included at one time.

Peaks, Valleys, Limits, Calculations

The 8500A or 8502A may be operated to store the highest and the lowest values in series of measurements for determining deviations, either directly or as a percentage. Or, where measurements are for testing whether certain values are within acceptable limits, preset limits may be entered and stored for comparison. Then, measurements within limits are classified simply as PASS. Measurements that fall outside of limits are classified as either HI or LO, depending on whether they exceed a high limit or fall below a low limit. These classifications appear in the display whether it is operated remotely or operated from the front panel.

Measured values may be multiplied by a factor before a numerical value is displayed. Or, using offset, both multiplied and added (or subtracted) using the general formula: Y = mx+b.

Triggered Measurements & Interfaces

Each measurement may be initiated externally with a simple trigger signal. Although triggering is primarily for systems applications which also require one of three interface options (-05, -06, or -07), it is also useful for less automated applications. The trigger signal may be derived from TTL circuits or any source that delivers a nominal 0 to +5 transition, a foot switch, for example.

Specifications

DC Volts

Range	Normal Full Scale	5½-Digit Resolution	Resistance
100 mV	312 mV	1 μV	>10,000 MΩ
1V	2.5V	10 μV	>10,000 MΩ
10V	20V	100 μV	>10,000 MΩ
100V	160V	1 mV	10 MΩ
1000V	1200V	10 mV	10 MΩ

Reading Rate (Bench Operation)
Fast: 7½ rdgs/s (60 Hz line); 6¼ rdgs/s (50 Hz line)
Slow: 1-7/8 rdgs/s (60 Hz line); 1½ rdgs/s (50 Hz line)

Accuracy, 6½-Digit: ±(% of Rdg + Counts)

Range	24 Hours 23°C±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient per °C[2]
100 mV[1]	0.002+4	0.003+5	0.005+8	0.0003+0.5
1V	0.001+6	0.002+8	0.004+9	0.0003+1
10V	0.0006 or 6*	0.001+8	0.002+9	0.0002+0.5
100V	0.001+6	0.002+8	0.004+9	0.0003+1
1000V	0.001+6	0.002+8	0.004+9	0.0003+0.5

** Whichever is greater*
[1] 5½-digit accuracy on lowest range
[2] 18°C to 0°C and 28°C to 50°C

Normal Mode Noise Rejection

Filter	Programmed 4 Samples/rdg	50 Hz 1-1/2 rds/s	60 Hz 1-7/8 rds/s
50 Hz, Fast	60 dB	75 dB	—
50 Hz, Slow	85 dB	95 dB	—
60 Hz, Fast	60 dB	—	—
60 Hz, Slow	90 dB	—	100 dB

Common Mode Rejection: 100 dB at 60 Hz with 1 kΩ unbalance
Overload: ±1200V dc or 1400V pk ac, may be applied continuously to any range without permanent damage
Common Mode Noise Rejection: ≥120 dB, dc to 60 Hz, with 100Ω unbalance

Ratio

Measurements of dc or ac voltage, dc or ac current, or resistance is divided by the measurement of an externally applied dc voltage and displayed as a ratio. The measurements are made on two separate isolated sets of terminals but there should be no more than 20,000 ohms between the Sense LO terminal and either the HI or LO Reference input terminal. Input characteristics of the Sense terminals depend on the function selected. Characteristics of the rear panel Ext Ref input are as follows:

Input Resistance: >10,000 MΩ
Max Reference Voltage: 40V dc between Ext Ref HI and LO terminals, providing neither terminal is greater than ±20V relative to the Sense LO or Ohms Guard terminal
Minimum Ext Reference Voltage: Equal to the input (voltage, current, or resistance) divided by 10X the range selected or 100 μV, whichever is greater
Ratio reading: <10 times the value of the volts, amps, or ohms range selected
Normal Mode Noise Rejection: ≥100 dB for dc and 1X and 2X line frequency
Common Mode Noise Rejection: ≥75 dB for 1X and 2X line frequency
Overload: ±180V peak, 127V rms relative to Sense LO terminal or Ohms Guard terminal
Accuracy: For reference voltages of 20V to 40V, accuracy is ±(A + B + 10 ppm), where A = 10V dc-range accuracy and B = input voltage-, current-, or resistance-range accuracy. For reference voltages less than 20V, accuracy is
$\pm(A + B + 200\text{ ppm}) \div V_{ref}$

Option Specifications

True-RMS AC Volts Option (-09A)

Range	Full Scale	5½-Digit Resolution	Impedance
1V	2.5V	10 μV	1 MΩ, <100 pF
10V	20V	100 μV	
100V	160V	1 mV	
1000V	1000V	10 mV	

Accuracy: ±(% of Rdg + % of Full Scale) (5½-Digits)

Frequency	90 Days, 18°C to 28°C		
	% of Input	+% FS (AC)	+% FS (AC + DC)
DC	0.1	—	0.03
10 Hz to 20 Hz	1.0	0.04	0.06
20 Hz to 50 Hz	0.5	0.012	0.03
50 Hz to 10 kHz	0.1	0.012	0.03
10 kHz to 30 kHz	0.2	0.04	0.06
30 kHz to 50 kHz	0.3	0.1	0.12
50 kHz to 100 kHz	1.0	0.3	0.3
100 kHz to 300 kHz	2.0	0.5	0.5
300 kHz to 1 MHz	3.3	1.8	1.8

1. *Filter must be used for full accuracy below 400 Hz. For 6½-digit display, multiply number of counts by 10*
2. *Volt-Hertz product not to exceed 2 x 10^7; 300 kHz to 1 MHz, not to exceed 1 x 10^7*
3. *For inputs above 500V, multiply accuracy by (2000V + V in) ÷ 2000V*

Common Mode Noise Rejection: ≥120 dB, dc to 60 Hz, with 100Ω unbalance
Crest Factor: >7 at full scale, increasing down scale by:

$7\sqrt{V\text{ Range} \div V\text{ Input}}$

Average-Sensing AC Volts Option (-01)

Range	Full Scale	5½-Digit Resolution	Impedance
1V	2.5V	10 μV	1 MΩ, <100 pF
10V	20V	100 μV	
100V	160V	1 mV	
1000V	1000V	10 mV	

Accuracy: ±(% of Rdg + Counts)*

Frequency	90 Days, 18°C to 28°C	
	1 mV to 500V**	Above 500V
30 Hz to 50 Hz	0.5 + 5	0.55 + 5
50 Hz to 10 kHz	0.05 + 5	0.1 + 5
10 kHz to 40 kHz	—	0.15 + 5
10 kHz to 50 kHz**	0.1 + 5	—
50 kHz to 100 kHz**	0.5 + 5	—

**Slow filter must be used below 400 Hz. For 6½-digit display, multiply number of counts by 10*
***On 1-volt range add 7 counts above 10 kHz or 35 counts above 50 kHz*

Common Mode Noise Rejection: ≥120 dB, dc to 60 Hz, with 100Ω unbalance

Resistance Option (-02)

Range	Full Scale	5½-Digit Resolution	Current Through Unknown
10Ω	31.25Ω	100 μΩ	10 mA
100Ω	250Ω	1 mΩ	10 mA
1 kΩ	2 kΩ	10 mΩ	1.25 mA
10 kΩ	32 kΩ	100 mΩ	78 μA
100 kΩ	256 kΩ	1Ω	9.8 μA
1 MΩ	4.096 MΩ	10Ω	4.9 μA
10 MΩ	32.768 MΩ	100Ω	0.61 μA
100 MΩ	262.144 MΩ	1 kΩ	76 nA

Accuracy: ±(% of Rdg + Counts) (5½-Digits)

Range	24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C
10Ω	0.003 + 20	0.005 + 20	0.01 + 20
100Ω	0.002 + 2	0.003 + 2	0.006 + 2
1 kΩ	0.002 + 1	0.003 + 1	0.006 + 1
10 kΩ	0.002 + 1	0.003 + 1	0.006 + 1
100 kΩ	0.002 + 1	0.003 + 1	0.006 + 1
1 MΩ	0.002 + 1	0.003 + 1	0.006 + 1
10 MΩ	0.01 + 1	0.02 + 1	0.04 + 1
100 MΩ	0.03 + 1	0.05 + 1	0.1 + 1

Open Circuit Voltage

Range	Voltage	Configuration
10Ω to 100 kΩ	7V max	4-terminal
1 MΩ to 100 MΩ	25V max	2-terminal

Overload: ±400V dc to 60 Hz, or 560V peak above 60 Hz max, continuous on any range with no damage

Reading Rate (Bench Operation)

Filter	Approximate rdgs per second			
	60 Hz		50 Hz	
	Fast	Slow	Fast	Slow
Fast	4	1-1/2	3-1/3	1-1/4
Slow	1-1/4	5/6	1	3/4

8500A/8502A

Current Option (-03)

Range	Full Scale	Resolution	Voltage Burden
100 µA	312 µA	1 nA	<100 mV
1 mA	2.5 mA	10 nA	<100 mA
10 mA	20 mA	100 nA	<200 mV
100 mA	160 mA	1 µA	<200 mV
1A	1.28A	10 µA	<500 mV

Overload: Fused at 1.5A, ±140V ac or peak ac to 60 Hz, 200V peak ac above 60 Hz with no damage
Settling and Digitizing Time: Same as dc volts

Direct Current Accuracy: ±(% of Input + Digits) (5½-Digits)

Ranges	24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C
100 µA	0.02 + 10	0.03 + 10	0.05 + 10
1 mA	0.02 + 10	0.03 + 10	0.05 + 10
10 mA	0.02 + 10	0.03 + 10	0.05 + 10
100 mA	0.03 + 20	0.05 + 20	0.1 + 20
1A	0.03 + 20	0.05 + 20	0.1 + 20

Alternating Current Accuracy: ±(% of Rdg + Counts) (5½-Digits)

Range	Frequency	90 Days, 18°C to 28°C	
		Avg-Res Current	True RMS Current
100 µA	10 Hz - 20 Hz	—	1.0 + 110
	20 Hz - 50 Hz	0.8 + 9	0.8 + 35
	50 Hz - 10 kHz	0.4 + 9	0.4 + 35
	10 kHz - 20 kHz	0.7 + 9	1.0 + 110
	20 kHz - 50 kHz	1.5 + 9	1.5 + 260
	50 kHz - 100 kHz	3.0 + 9	4.0 + 760
1 mA and 10 mA	10 Hz - 20 Hz	—	1.0 + 110
	20 Hz - 50 Hz	0.5 + 9	0.5 + 35
	50 Hz - 10 kHz	0.06 + 9	0.11 + 35
	10 kHz - 20 kHz	0.11 + 9	0.2 + 110
	20 kHz - 50 kHz	0.12 + 9	0.3 + 260
	50 kHz - 100 kHz	0.51 + 9	1.0 + 760
100 mA	10 Hz - 20 Hz	—	1.0 + 150
	20 Hz - 50 Hz	0.5 + 55	0.5 + 80
	50 Hz - 10 kHz	—	0.26 + 80
	50 Hz - 100 kHz	0.24 + 55	—
1A	10 Hz - 20 Hz	—	1.0 + 160
	20 Hz - 50 Hz	0.5 + 65	0.5 + 90
	50 Hz - 10 kHz	0.24 + 65	0.26 + 90

Applies from 0.1% of full scale to full scale

Crest Factor (True-RMS): >4.5 at full scale, increasing down scale by $4.5\sqrt{\text{Irange} \div \text{Iinput}}$

Calibration Memory Option (-04)

Allows correction factor to be entered and stored for any or all ranges of any or all measurement functions, quickly and conveniently. Prevents downtime in calibration laboratory.
Control: Via front panel pushbuttons
Storage Time: 1 year if not used. Up to five years if used
Calibration Points: Decade value for each range

IEEE Interface Option (-05)

The IEEE Interface provides I/O compatability per IEEE Std 488-1978. Order 1m, 2m, or 4m cable separately (Y8021, Y8022, Y8023)

RS-232 Interface Option (-06)

This bit serial asynchronous interface option provides either voltage loop (EIA Standard RS-232-B or -C) or current loop (20 mA for Teletype) for interfacing to such things as computers, CRT displays, DEC writers, Teletypes, etc. Eight baud rates are available from 110 to 9600 and either one or two stop bits can be set up. Selection is made via rear panel logic switches.

Parallel Interface Options (-07A,-07B,-07D,-07H,-07L)

These 16-bit parallel, character-serial interface options allow the 8500A or 8502A to interface to several mini-computers at a full 500 readings/second. Can be used for interfacing to 8-bit multiplex microcomputers or controllers. Both ASCII and binary (2's complement) coding are selected via command codes.

General Specifications

Temperature: 0°C to 50°C, operating; -40°C to 70°C, non-operating
Overload: LO to guard is 100V max; guard to chassis is 1000V max
Power: 100, 120, 220 or 240 Volt, 47-63 Hz <25W with all options
Warmup: 1 hr to rated accuracy
Dimensions: 10.8 cm H x 42.5 cm L x 43.2 cm W (4.25 in H x 16.75 in L x 17 in W)
Weight: Basic is 9.1 kg (20 lb). All options are 11.3 kg (25 lb)
Included: Manual, power cord and Option -08 (8500A) or Option -08A (8502A). Order Y8133, or Y8140 test leads separately. Serialized and dated calibration certification sheet

Models

	January 1986 prices
8500A DMM	$4710
8502A DMM	4725

Options for 8500A and 8502A***

8500A-01 Average Converter	615
8500A-02 Ohms Converter	770
8500A-03 Current Converter	510
8500A-04 Cal Memory	495
8500A-05 IEEE-488 Interface	530
8500A-06 RS-232-C Interface	530
8500A-07A Parallel Interface (for DEC PDP11, DRIIC or DRVII)	530
8500A-07B Parallel Interface (for DEC PDP11, PC11)	530
8500A-07D Parallel Interface, general purpose	530
8500A-07H Parallel Interface (for HP12566 or 98032A)	530
8500A-07L Parallel Interface, low noise (for DEC PDP11, DRIIC, or DRVII)	530
8500A-08* Interface Isolator	260
8502A-08A* Interface Isolator	240
8500A-09A RMS Converter	670
8502A-16** Switchable Front/Rear Inputs	525
8500A-17 Parallel Front/Rear Inputs	220

* *Required when using any interface option. Option -08 now included with 8500A. Option -08A now included with 8502A.*
** *For 8502A only*
*** *All options except -16 are customer installable*

Accessories (Also see page 57)

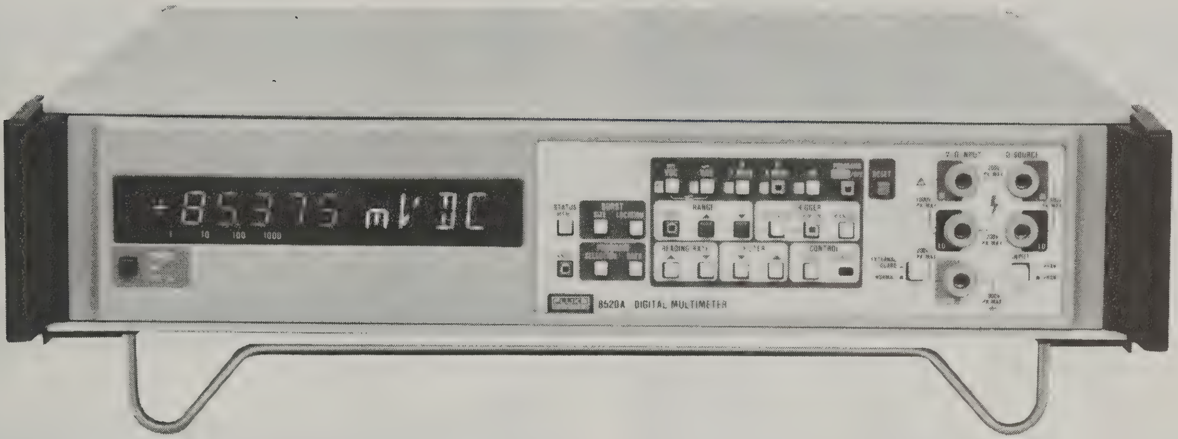
MIS-7011K Extender Card	135
MIS-7013K Bus Interconnect and Monitor	45
MIS-7190K Static Test Controller	285
MIS-7191K Test Module	475
M00-260-610 18" Rack Slide Kit (rack adapter req'd)	105
M04-205-600 5¼" Rack Adapter	95
Y8021 1m, IEEE-488 Shielded Cable	85
Y8022 2m, IEEE-488 Shielded Cable	95
Y8023 4m, IEEE-488 Shielded Cable	105
Y8133 Universal Test Leads	20
Y8140 Slim Test Leads	18

Also see page 230 for more accessory information.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

8520A, 8522A, 8520A/AS-1, 8520A/PRT



8520A

Intelligent DMMs for Bench or System

- DC and ac volts
- 2 and 4-wire ohms
- Conductance
- 520 readings per second
- 20 ppm basic dc accuracy
- Burst memory and math capabilities
- Standard system interfaces
  8520A IEEE-488
  8522A: Parallel and BCD
- New 8520A/AS-1 MATE certified DMM

The 8520A and 8522A are designed for system and bench applications and have built-in system interface circuits. The performance specifications of the two instruments are almost identical. The principal difference is that the 8520A has an interface compatible with IEEE Std 488-1978 and the 8522A has an interface suitable for either BCD or Parallel (binary) applications.

The 8520A/AS-1 and the 8520A/PRT are unique variations of the 8520A. One, the 8520A/AS-1, is compatible with U.S. Government Modular Automatic Test Equipment (MATE) system. And the 8520A/PRT includes a Platinum Resistance Probe for extremely accurate temperature measurements.

Seven standard and seven optional math programs plus a built-in "burst" memory make these multimeters exceptionally intelligent stand-alone units. A choice of dc volts, true-rms ac volts, 2-wire or 4-wire ohms, and the Fluke exclusive conductance function make the instruments very versatile. The conductance function provides a simple way to measure resistance from 10 MΩ to 100,000 MΩ.

The instruments boast 50 ppm basic dc accuracy for 90 days with 5½-digit resolution. A 520 readings-per-second system rate with 4½-digits resolution is standard for high speed measurements. Or make 240 readings per second (with 60 Hz line operation) with 5½-digits resolution. Inputs are switchable from front to rear too.

An unprecedented degree of prompting and operational cues are provided for skilled and unskilled technicians alike. A simple, uncluttered color-coded front panel makes operation easy.

Math Programs

Fourteen pre-programmed functions are available for the 8520A, 8520A/AS-1, 8520A/PRT, and 8522A. The first seven are standard; eight through fourteen are also standard on the 8520A/AS-1 and 8522A but optional on the other models. For systems use, these powerful programs will reduce software overhead greatly. They also simplify and speed testing for ordinary bench applications. Up to three math programs can be chained or stacked for simultaneous use.

The standard programs

1 = TEST. Four separate internal test programs do diagnostic checks on analog circuitry, digital hardware and software, and the front panel keys and displays.
2 = ZERO. Eliminates the effect of lead resistance for ohms tests and subtracts low-level dc components in the dc voltage function.
3 = XREF (external reference). Compares an unknown voltage at the front panel to a known rear-panel input. The display is the ratio of the front and rear inputs.
4 = OSR (offset/scale/ratio). Allows you to enter any constant in the formula (X = measurement *minus* offset *times* scale *divided* by ratio) from the keyboard, the memory, or a current reading.
5 △ PCT (percent deviation). Compares all subsequent readings with a stored nominal value. The display appears as plus or minus a percentage deviation.
6 = PEAK. Constantly monitors the maximum and minimum readings. These values can be recalled as well as the "peak-to-peak" variation.
7 = LIM (limits). Turns the multimeter into a sorting machine. Inputs are sorted and displayed in three ways — "High," "Pass" and "Low," based on previously stored upper and lower limits. You can recall the number of high, low, and pass readings, plus the total number of readings.

The other programs (part of Option -010) Standard in 8520A/AS-1 & 8522A

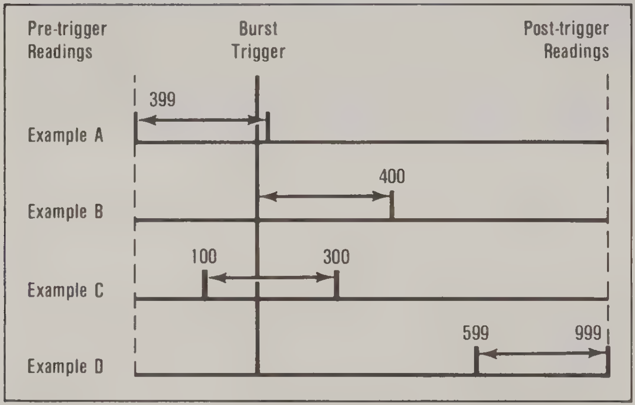
8 = STAT (statistics). Computes the mean, standard deviation, and variance of readings taken or data stored in memory registers.
9 = LFAC. A unique way to accurately measure low frequency ac signals from dc to 10 hertz.
10 = dB. Calculates dB, dBm or dBV of a measured value and displays dB.
11 = RTD. Implements equations which convert the resistance of a resistance temperature detector (RTD) to temperature in °C. Readouts in K or °F are also selectable.
12 = JVC (junction voltage Celsius). Computes °C, °F, or K based on inputs from a Fluke 80T-150C Temperature Probe (calibrated for °C).
13 = JVF (junction voltage Fahrenheit). For use with the Fluke 80T-150F (calibrated for °F). Performs the same operations as Program 12.
14 = THMS (thermistor linearization). Converts the resistance of a thermistor to temperature in °C, °F, or K.

Burst Memory (Reading Storage)

The unique burst memory lets you store up to 50 readings at any reading rate (400 readings with Option -010). In fact, the most recent 50 (or 400) readings are always stored in a shift register and available for recall and analysis whenever measurements cease. In the burst mode the storage operation may be independently triggered to capture a particular group of successive readings that may occur before, after, or both before and after the trigger instant. The storage of readings may be delayed after the trigger, as shown in example D, below.

Stored readings can be recalled individually or scanned in sequence for display on the front panel. Or they may be transferred to a controller or computer via the interfaces available in the 8520A or 8522A. Math processing can be applied to readings stored in memory as they are recalled.

Burst memory, (400 readings part of Option -010)



With Option -010, the burst memory may capture any group of 400 successive readings that occur within 399 readings prior to and 999 readings following the burst trigger. In example A, only one reading is taken after the trigger point. In example B, 400 readings immediately following the burst trigger are captured. Example C shows storage of 100 readings prior and 300 readings after the trigger point. The last example shows 400 readings being stored commencing 599 readings after the trigger.

8522A — Parallel and BCD Interface

Speed and real-time measurement are key system elements available in the 8522A when the Parallel (binary) interface is selected. That interface offers both a three- and a four-wire handshake (switch-selectable) for use with the most popular parallel computer interfaces. A choice of *eight-* or *sixteen-* bit messages are selectable at the rear of the instrument.

The BCD interface emulates BCD remote operation of the Fluke 8375A and 8400A, for the convenience of customers who wish to replace these or any of a large variety of older DMMs in their system. Remote control and data output capabilities are the same as those of the 8375A and 8400A. All but the conductance function may be controlled remotely, plus the range filter and external reference.

Output of readings include five BCD digits, an overrange bit, an overload bit, polarity bit, and three coded range bits. Status output includes function, filter, external reference and remote/local.

8520A/AS-1 — for MATE Systems

The 8520A/AS-1 is equipped with a built-in interface interpreter which makes it compatible with Modular Automatic Test Equipment (MATE) systems. This capability allows a MATE Test Executive to operate the 8520A/AS-1 on the IEEE-488 bus using Control Interface Intermediate Logic (CIIL). It will operate in either the "CIIL Mode," responding only to CIIL commands or in the "native mode," responding to either CIIL commands or 8520A device dependent IEEE-488 commands. Data transmission is increased to 120,000 characters per second for direct memory access using the CIIL mode.

The 8520A/AS-1 was the first candidate module to become MATE certified.

8520A/PRT — Temperature Measurements

The 8520A/PRT is a temperature measurement system consisting of a Rosemount 162N Platinum Resistance Thermometer (PRT) and an 8520A containing a built-in linearization program customized to match the calibration curve of the specific PRT supplied. Temperature is indicated directly in either °C, °F or K with 0.001 degree resolution.

The 8520A/PRT provides a fast, low-cost way of making extremely accurate temperature measurements, or calibrating temperature measurement instruments, in the range of -200°C to +350°C. Systems using four-terminal resistance bridges are much more time-consuming to use, require greater expertise, are limited in their applications, and are far more costly.

Measurements are repeated approximately once per second, making it possible to detect and track fast temperature changes, something impractical to try to do with balance bridges.

Specifications

DC Voltage

Range	Full Scale	Resolution	Input Resistance
100 mV	199.999	1 μV	⩾10,000 MΩ
1V	1.99999	10 μV	⩾10,000 MΩ
10V	16.0100	100 μV	⩾10,000 MΩ
100V	130.100	1 mV	10 MΩ
1000V	1024.00	10 mV	10 MΩ

Accuracy: ±(% of Input + Digits)

Range	24 Hours 23°C ± 1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temp. Coefficient per °C*
100 mV	0.003 + 5	0.0065 + 6	0.011 + 10	0.0005 + 0.5
1V	0.003 + 1	0.006 + 2	0.011 + 2	0.0005 + 0.15
10V	0.002 + 1	0.005 + 1	0.009 + 1	0.0004 + 0.10
100V	0.003 + 1	0.007 + 2	0.012 + 2	0.0005 + 0.15
1000V	0.0035 + 1	0.0065 + 1	0.011 + 1	0.0005 + 0.10

**From 18°C to 0°C or 28°C to 50°C*

High Speed Accuracy: ±(% of Input + LS Bit)*

Range	90 Days 18°C to 28°C	1 Year 18°C to 28°C	Plus Temperature Coefficient Per °C
100 mV	0.01 + 1	0.015 + 1	0.001 + 0.1
1V-1000V	0.01 + 1	0.015 + 1	0.001 + 0.05

** Typical with 60 Hz line, remote operation, 500 readings per second, 2-byte binary output with 14 bits of data.*

Normal Mode Rejection

Line Freq.	Filter Setting Time					
	25 ms	50 ms	100 ms	200 ms	500 ms	1s
50 Hz	65 dB	68 dB	71 dB	80 dB	83 dB	86 dB
60 Hz	65 dB	68 dB	71 dB	85 dB	88 dB	91 dB

Common Mode Rejection: True, 100 dB at 50 Hz and 60 Hz with 1 kΩ unbalance in either lead. Effective CMR is equal to normal mode rejection plus true CMR

Maximum Input: ±1000V peak, High to Low or Guard to chassis terminals, and ±200V peak, Guard to Low terminals, for any range

Bias Current: ⩽50 pA

Maximum Reading Rate

Operation	Line	Rate	Resolution
Local or Remote	50 Hz	200 rdgs/sec*	5½ digits
	60 Hz	240 rdgs/sec*	
Remote	50 Hz	>500 rdgs/sec	4½ digits
	60 Hz	>500 rdgs/sec	

**For local operation, 8522A is limited to ½ this rate.*

AC Voltage (True - RMS)

Input Characteristics

Range	Full Scale	Resolution	Input Impedance
1V	1.99999	10 μV	1 MΩ, ≤100 pF
10V	16.0100	100 μV	
100V	130.100	1 mV	
650V	650.00	10 mV	

Accuracy: ±(% Input + % of Full Scale) ac or ac+dc*

Frequency	90 Days 18°C to 28°C			1 Year 18°C to 28°C		
	% of Input	+% FS AC	+% FS AC+DC	% of Input	+ % FS AC	+% FS AC+DC
10 Hz to 20 Hz**	3.0	0.6	0.7	3.5	0.6	0.7
20 Hz to 40 Hz**	0.5	0.5	0.6	0.6	0.6	0.7
40 Hz to 20 kHz	0.1	0.03	0.08	0.15	0.05	0.16
20 kHz to 100 kHz	1.0	0.3	0.4	2.0	0.6	0.8
100 kHz to 300 kHz	2.4	0.6	0.6	4.0	0.1	0.1
300 kHz to 1 MHz	8.0	2.5	2.5	15.0	5.0	5.0

**From 0.1% of range to full scale. For 650V AC range, multiply % FS by 1.6*
***With statistics math program #8*

Temp. Coefficient: 18°C to 0°C or 28°C to 50°C, to 20 kHz
AC Mode: ±(0.007% of input + 0.007% FS)/°C
AC+DC Mode: ±(0.007% of input + 0.14% FS)/°C
Maximum Input: ±1000V peak High to Low or Guard to Chassis terminals, and ±200 V peak Guard to Low terminals
Crest Factor: ≥4:1 at full scale, increasing down scale
Maximum Reading Rate: 10 readings per second
Maximum Slew Rate: 177V per μs
Maximum Volt-Hertz Product: 2 x 10^7

Resistance

Input Characteristics

Range	Full Scale	Resolution	Current Through Unknown	Open Circuit Voltage
10Ω	19.9999	100 μΩ	10 mA	7V
100Ω	199.999	1 mΩ	10 mA	
1000Ω	1999.99	10 mΩ	1.0 mA	
10 kΩ	19.9999	100 mΩ	0.1 mA	
100 kΩ	199.999	1Ω	14.5 μA (max)	
1 MΩ	1.99999	10Ω	1.5 μA (max)	
10 MΩ	19.999	1kΩ	1.5 μA (max)	

Maximum Input: ±400V peak for any range
Maximum Reading Rate: 100 kΩ range and higher, reading rate is 10 rdgs/second

10 kΩ Range and Lower

Operation	Resolution	Line	Reading Rate
Local or Remote	5½-digits	50 Hz	200 rdgs/sec*
		60 Hz	240 rdgs/sec*
Remote	4½-digits	50 Hz	>500 rdgs/sec*
		60 Hz	>500 rdgs/sec*

**For local operation, 8522A is limited to ½ this rate.*

Accuracy: ±(% of Input + Digits)

Range	24 Hours 23°C ± 1°C	90 Days 18° C to 28°C	1 Year 18°C to 28°C	Plus Temp Coefficient per °C*
10Ω	0.0045 + 6	0.0080 + 7	0.0140 + 12	0.0007 + 2.0
100Ω	0.0035 + 2	0.0070 + 2	0.0125 + 3	0.0007 + 0.2
1000Ω	0.0035 + 2	0.0070 + 2	0.0125 + 3	0.0007 + 0.2
10 kΩ	0.0035 + 2	0.0070 + 2	0.0125 + 3	0.0007 + 0.2
100 kΩ	0.0040 + 2	0.0090 + 2	0.0140 + 3	0.0012 + 0.2
1 MΩ	0.0090 + 2	0.0160 + 2	0.0200 + 3	0.0020 + 0.2
10 MΩ	0.0300 + 1	0.0440 + 1	0.0450 + 3	0.0030 + 0.2

**From 18° C to 0° C or 28° C to 50° C*

Conductance

Range: 100 nS (10 MΩ)$^{-1}$
Full Scale: 199.99
Resolution: 0.01 nS (100,000 MΩ)$^{-1}$
Accuracy: ±(% of Input + Digits)

24 Hours 23°C ± 1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C	*Plus Temp Coefficient per °C
0.04 + 5	0.05 + 5	0.06 + 5	0.004 + 1

**From 18° C to 0° C or 28° C to 50° C*

Maximum Input: ±400V peak
Maximum Reading Rate: 10 readings per second

External Reference

Operating Range: ±0.5V dc to ±33V dc as long as external reference Low terminal is within ±16.5V of input Low terminal
Input Impedance: 10,000 MΩ between external reference High or Low terminals and input Low terminal
Ratio Accuracy

X-Ref Voltage	Accuracy
16.5V to 33V	±(A + B + 20 ppm)
0.5V to 16.5V	±[A + B + (400 ppm ÷ |Vref|)]

Note: A = DC 10 volt range accuracy
B = Input voltage or resistance range accuracy

Maximum Input: ±180V peak between external reference High or Low and input Low; ±360V peak between external reference High and Low

Transfer Accuracy

The following accuracy specifications apply when:

- Reading rate is 2 readings per second
- Filter settling time is 500 ms
- Warm-up is at least 2 hours
- Quantity measured has same nominal value and frequency as transfer standard
- Measurements are made in one range
- Standard is checked at least every hour
- Ambient temperature remains within ±1°C

DC Voltage

Range	±(% of Input + digits)
100 mV	0.0020 + 4
1V	0.0020 + 1
10V	0.0010 + 1
100V	0.0020 + 1
1000V	0.0020 + 1

AC Voltage (all ranges)

Frequency	±(% of input + % of Full Scale)
10 Hz to 20 Hz	1.0 + 0.2
20 Hz to 40 Hz	0.1 + 0.1
40 Hz to 20 kHz	0.005 + 0.009
20 kHz to 100 kHz	0.100 + 0.030
100 kHz to 1 MHz	0.500 + 0.60

DIGITAL MULTIMETERS

8520A, 8522A, 8520A/AS-1, 8520A/PRT

Resistance

Range	±(% of Input + Digits)
10Ω	0.0030 + 5
100Ω	0.0020 + 2
1000Ω	0.0020 + 2
10 kΩ	0.0020 + 2
100 kΩ	0.0020 + 2
1 MΩ	0.0050 + 2
10 MΩ	0.0100 + 1

Conductance (100 nS range): ±(0.02% of input + 0.02 nS)

General Specifications

IEEE-488 Interface: Standard in the 8520A, 8520A/AS-1 and 8520A/PRT

Parallel (Binary) and BCD Interface: Standard in 8522A

BCD Data Output: Standard 0V and +5V TTL levels positive true, 8-4-2-1 code. Five BCD digits with an overrange bit, overload, polarity, and three coded range bits. The output also includes the state of the instrument (function, filter, external reference, and remote or local).

BCD Remote Control: Standard TTL levels — Logic 1 equals +5V or open, Logic 0 equals 0V or contact closure. Controls all functions (except conductance), range, filter (fast, slow), and external reference. Continuous-command entry and triggered-command entry.

Parallel: In bit parallel operation all features and functions can be accessed through the remote interface. Maximum speed in this mode is 520 readings per second

Format: Select 8 or 16-bit message format with a rear panel switch

Handshake: The handshake configuration is also switch selectable 3- or 4-wire for compatibility with computers, mini-computers, and instrument controllers

Temperature: 0°C to 50°C, operating; -25°C to +75°C non-operating; for 8520A/AS-1, non-operating temperature range is -40°C to +75°C

Relative Humidity: ≤95% to 25°C, ≤75% to 40°C, ≤45% to 50°C

Shock & Vibration: Meets MIL-T-28800C for Type III, Class 5, Style E

Power: 100, 120, 220, or 240V ac, ±10%, 50 to 60 Hz, ≤50W

Size: 8.9 cm H x 45.7 cm L x 43.2 cm W (3½ in H x 18 in L x 17 in W)

Weight: 9.56 kg (21 lb)

Included: Manual, power cord, rear panel mating connector for analog input, serialized and dated calibration certification sheet

Models

January 1986 prices

8520A DMM with IEEE-488 Interface	$3145
8522A DMM with BCD and Parallel Interface	4510
8520A/AS-1 DMM for MATE	4595
8520A/PRT Temperature Measurement System	6630

Option

8520A-010* Extended Software Package	500

**Included with 8520A/AS-1 and 8522A*

Accessories (Also see page 57)

Y9111 0.93m, 3 ft Trigger Cable	20
Y9112 1.85m, 6 ft Trigger Cable	20
Y8133 Test Lead Set	20
Y2037 100Ω RTD Temperature Probe	260
Y8021 1m, IEEE-488 Shielded Cable	85
Y8022 2m, IEEE-488 Shielded Cable	95
Y8023 4m, IEEE-488 Shielded Cable	105
Y8597 Adapter for 8375A, 8400A	150
Y8598 3½" Rack Adapter with 22" slides	100
Y8599 3½" Rack Adapter only	65

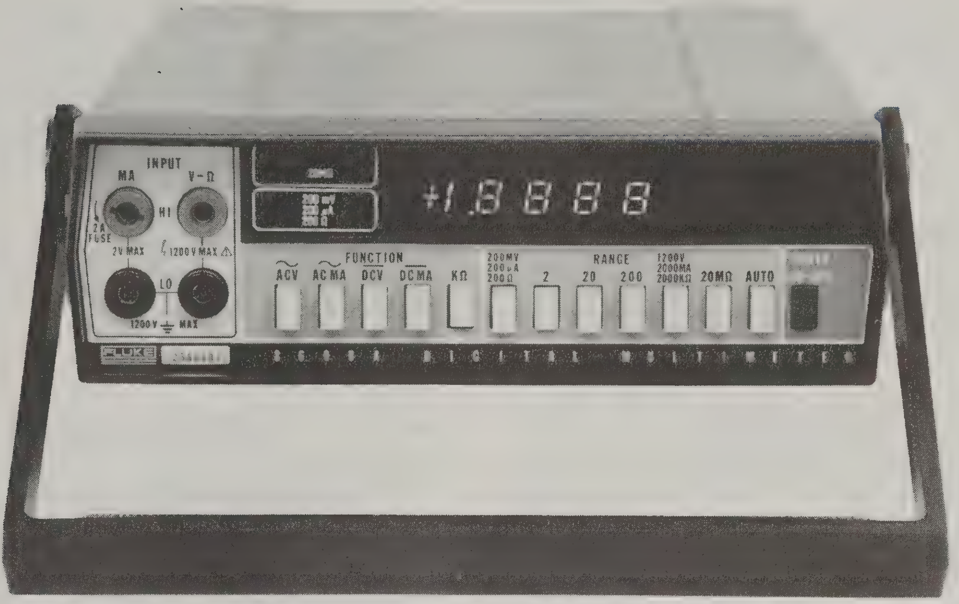
Also see page 230 for more accessory information.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

Conversion of 8520A/AS

Conversion of 8520A/AS to 8520A/AS-1 is available from your Fluke Service Center. Order 8520A/AS/AS1. The price of the conversion is $950.



8600A

8600A, Autoranging

- 4½-digit resolution
- ±0.02% 6 month basic dc accuracy
- Autoranging
- Dc and ac voltage ranges to 1200V
- Dc and ac current ranges to 2 amps
- Resistance to 20 MΩ
- Rechargeable battery version
- Data output options

The 8600A is a 4½-digit multimeter featuring high accuracy and full autoranging capability except for current. Measurement functions include ac volts, dc volts, ac current, dc current, and resistance. Available options include a rechargeable battery pack (–01) for portable operation, a parallel BCD printer output (–02), Option –521 for Fluke 2030A or 2020A Printer, and Option –529 for operation on the IEEE-488 bus via the 1120A Translator. Superior reliability is assured through a high impact plastic case, LSI construction, dual slope measurement techniques and extensive input overload protection on all ranges. All dc voltage ranges will withstand ±1200V dc or 1700V peak ac without damage. Similarly, all ac voltage ranges will endure 1200V rms without damage. The resistance ranges can handle continuous 250V rms or dc inputs without damage. All current ranges are protected by a 2A fuse which is replaceable from the front panel.

Specifications

All accuracy specifications are for 6 months with a room temperature of 15°C to 35°C.

DC Voltage

Ranges: ±200mV, ±2V, ±20V, ±200V, ±1200V
Ranging: Full autoranging or manual ranging
Polarity: Automatic, + and – displayed
Resolution: 10 μV on 200 mV range
Accuracy: ±(0.02% of input +0.005% of range) for 2, 20, 200V ranges; ±(0.02% of input +0.008% of range) for 1200V range; ±(0.04% of input +0.01% of range) for 200 mV range
DC Input Resistance: >1000 MΩ on 200 mV and 2V ranges. 10 MΩ on 20V, 200V, and 1200V ranges
Zero Stability: Autozero on all ranges
Overload Protection: ±1200V dc or ±1700V peak ac applied continuously to any range
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB (with 1 kΩ in either lead) at dc, 50 Hz, and 60 Hz
Response Time: 1.0s max to rate accuracy, within range

AC Voltage (Average-Sensing)

Ranges: 200 mV, 2V, 20V, 200V, 1200V
Ranging: Full autoranging or manual ranging
Resolution: 10 μV on 200 mV range

Accuracy: ±(% of Input + % of Range)

Range	30 Hz	50 Hz	10 kHz	20 kHz	50 kHz	100 kHz
200 mV (1% to 100%)	0.5+0.1	0.2+0.08	0.5+0.1		0.5+0.5	
2V, 20V, 200V (1% to 100%)	0.5+0.025	0.2+0.015	0.5+0.025		1.0+0.05	
1200V 10V-500V 500V-1200V	 0.5+0.08 0.5+0.08	 0.2+0.03 0.37+0.03	 0.5+0.08 0.5+0.08	Not Specified		

Input Impedance: 2 MΩ shunted by <100 pF
Overload Protection: 1200V rms maximum, not to exceed 2 x 10^7 volt-hertz product
Response Time: 1.5s max to rated accuracy within range

DC Current

Ranges: 200 μA, 2 mA, 20 mA, 200 mA, 2000 mA
Ranging: Manual ranging
Resolution: 10 nA on 200 μA range
Accuracy: ±(0.1% of input +0.01% of range) on all ranges
Voltage Burden: 0.5V max at 2A, 0.25V max to 200 mA
Overload: Protected to 2A on any range; fused above 2A
Response Time: 1.0s max to rated accuracy within range

AC Current

Ranges: 200 μA, 2 mA, 20 mA, 200 mA, 2000 mA
Ranging: Manual ranging
Resolution: 10 nA on 200 μA range
Accuracy: 50 Hz - 10 kHz, ±(0.3% of input + 0.08% of range) all ranges, except 50 Hz - 5 kHz on 2000 mA range; 30 Hz - 50 Hz ±(0.6% of input +0.1% of range) all ranges
Voltage Burden: 0.5V max at 2A, 0.25V max to 200 mA
Overload: Protected to 2A on any range; fused above 2A
Response Time: 1.5s max to rated accuracy within range

Resistance

Ranges: 200Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ, 20 MΩ
Ranging: Full autoranging or manual ranging
Resolution: 10 mΩ on 200Ω range
Configuration: 2 wire
Accuracy:
±(0.1% of input +0.15% of range) 200Ω range
±(0.1% of input +0.005% of range) 2 kΩ range
±(0.05% of input +0.005% of range) 20 kΩ to 2000 kΩ range
±(0.2% of input +0.005% of range) 20 MΩ range
Open Circuit Voltage: ≤5V
Overvoltage Protection: 250V rms or dc, applied continuously
Response Time: 1.0s max to rated accuracy within range, (200Ω range to 2000 kΩ range), 4s max on 20 MΩ range

Current Through Unknown

200Ω	2 kΩ	20 kΩ	200 kΩ	2000 kΩ	20 MΩ
1 mA	1 mA	100 μA	10 μA	1 μA	0.1 μA

Battery Pack Version (8600A-01)
Internal rechargeable battery pack, 8 hours typical operation, rechargeable in 16 hours max. Not compatible with Option -02.

Option Specifications

Digital Output Version (8600A-02)

Isolated parallel BCD output, TTL/DTL compatible levels. Not compatible with Version -01.

PTI Interface Option (-521)

For automatically logging measured data using a Fluke 2020A-004 or 2030A Printer. Y7203 interface cable (included) may be paralleled with other Fluke PTI instruments and addressed sequentially by the printer. This option is part of Option 8600A-529 and only outputs data.

1120A Interface Kit (-522K)

When Kit -522K is added to Option -521, (or Kit -521K), the two perform the same as Option 8600A-529. The kit consists of a DVM personality card for the Fluke 1120A Translator.

IEEE-488 Interface Option (-529)

The 8600A will operate with other instruments on the IEEE-488 bus using Option 8600A-529 and the Fluke 1120A Translator. Only outputs data.

General Specifications

Function: Selected via front panel controls
Range: Automatic or manual, selected via front panel controls
Autorange Rate: 600 ms max per range change
Display: 7 segments 0.3 LED display, automatic decimal location
Reading Rate: 2½ samples/second within range
Overload Indication: Flashing display of +18888 (built-in segment test of LED display) for out of range indication
Temperature: 0°C to +50°C, operating; −40°C to +75°C, −40°C to +60°C with batteries, non-operating
Relative Humidity: ≤80%, +5°C to +35°C; ≤70%, +35°C to +50°C
Shock and Vibration: Meets pertinent requirements of MIL-T-28800C
MTBF: 10,000 hours calculated, minimum
Common Mode Voltage: 1000V dc or peak ac, max
Power: 115 or 230V ac ±10%, 50 or 60 Hz, 7 watts line, 10 watts battery
Size: Excluding handle, 6.4 cm H x 21.6 cm W x 25.4 cm D, (2.52 in H x 8.5 in W x 9.9 in D)
Weight: 1.6 kg (3.5 lb) line; 2.1 kg (4.5 lb) w/batteries

Models

January 1986 prices

8600A Digital Multimeter	$825
8600A-01 DMM with rechargeable batteries	905

Options

8600A-02 Data Outut Option (Not customer installable)	200
8600A-521 PTI Interface	200
8600A-521K PTI Interface, kit, field-installable*	250
8XXXA-522K 1120A Interface, kit, field-installable	135
8600A-529 IEEE-488 Interface**	325

**Not compatible with 8600A-01 or 8600A-02*
***Includes -521, -522K, and Y7203 Cable. Requires 1120A IEEE-488 Translator.*

Accessories (Also see page 57)

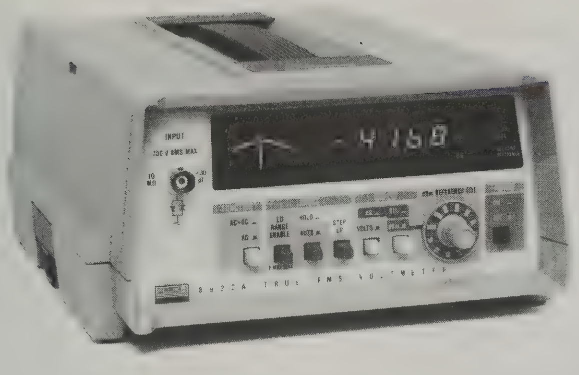
80K-6 High Voltage Probe	45
80K-40 High Voltage Probe	80
85RF RF Probe	85
80T-150U Temperature Probe	120
80TK Thermocouple Module	59
80i-400 Clamp-On Current Probe	69
80i-600 Clamp-On Current Probe	109
80J-10 Current Shunt	30
M00-100-714 Panel Protector	10
M00-200-611 3½" Rack Adapter, Offset	35
M00-200-612 3½" Rack Adapter, Center	35
M00-200-613 3½" Rack Adapter, Dual	50

Also see page 230 for more accessory information.

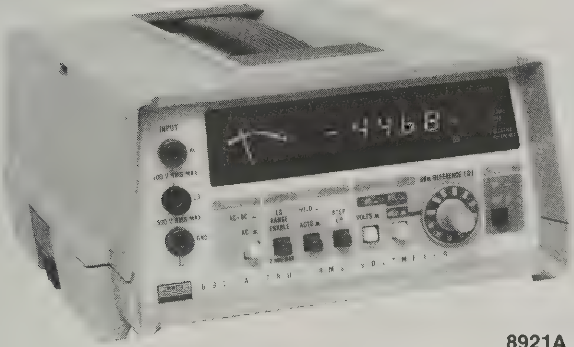
After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

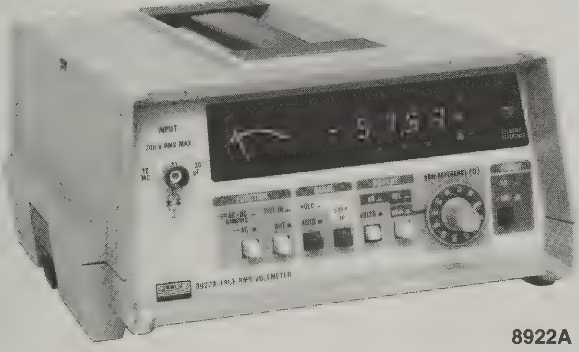
8920A/8921A/8922A



8920A



8921A



8922A

8920A/8921A/8922A, Wideband

- True-rms ac
- Ac or ac + dc measurements
- Autoranging
- 4-digit display
- Analog display for peak/null adjustments
- Rear panel linear analog output (Models 8920A & 8922A)
- Relative dB reference
- 2 Hz to 11 MHz (Model 8922A)
- 180 μV to 700V

Choice of Bandwidth

Bandwidth capabilities of the 8920-Series Voltmeters encompass many applications, from testing high-frequency oscillators, attenuator flatness and amplifier frequency response to microphone levels, phono-pickup devices, vibration tests and wideband noise levels — to list only a few. Models 8920A and 8921A cover a bandwidth of 10 Hz to 20 MHz. The 8922A offers low-frequency capabilities in the 2 Hz to 11 MHz bandwidth and a switchable 200 kHz low pass filter which eliminates unwanted high-frequency noise from the measured signal.

Selectable dBm Reference Levels

Fluke's 8920-Series Voltmeters permit an operator to select any one of 12 reference impedances from 50Ω to 1200Ω and to digitally read out dB values referenced to the selected level. Input impedance is constant at 10 MΩ for all settings of the dB reference control. This minimizes circuit loading and allows the operator to add the appropriate termination externally. Zero dB corresponds to 1 mW for each of the selectable levels.

True RMS Converter

The heart of all 8920-Series Voltmeters is Fluke's monolithic thermal converter which can measure rms values of an ac signal. This patented semiconductor circuit balances the heating power of a dc feedback signal against the heating power of the ac input voltage, producing a *true* rms equivalent dc output. This unique converter enables Fluke voltmeters to provide wideband, low-noise, accurate measurements at a low cost.

AC or AC + DC Functions

Until Fluke introduced its 8920-Series Voltmeters, only the most expensive meters offered ac + dc coupling. Without this feature, whenever an operator is required to measure a signal which (1) is not symmetrical, (2) has unequal excursions above and below zero, or (3) has a dc component, it is necessary to go through a series of computations to determine the actual rms voltage value. First, the signal has to be measured with a dc voltmeter (providing its ac rejection is sufficient) and then with an ac voltmeter. Finally, the sum of the squares of the two readings must be calculated and the square-root extracted from the result. Failure to consider the dc component by using only an ac-coupled meter can result in substantial error.

Relative dB Reference

The relative reference feature of the 8920-Series Voltmeters allows direct readings of gain or attenuation. Depressing the REL switch sets the existing dB reading to zero, establishing the input voltage level as the relative dB reference. Subsequent readings of higher voltages will be displayed as +dB, lower voltages as -dB.

Meters lacking this feature require an operator to record a desired reference level and then add or subtract it from subsequent readings to arrive at the relative dB value — a tedious and time-consuming procedure.

Autoranging

Fluke's autoranging feature allows you to carry out your testing without having to change ranges manually. A range can be placed on HOLD or manually stepped up to a higher range. On HOLD, the meter will remain in a given range regardless of changes in input levels. On STEP UP, the meter will increase ranges step-by-step until the switch is released.

Peaking/Dipping Meter

In addition to an accurate digital display, all Fluke Voltmeters in the 8920-Series feature an analog meter for peak and null voltage adjustments. The meter indicates 0 to 100 percent full scale in each range.

Linear Analog Output

Models 8920A and 8922A are equipped with a rear panel output for driving X-Y or strip chart recorders, delivering voltages proportional

DIGITAL VOLTMETERS

8920A/8921A/8922A

to the display count. A 2-volt level equals 2000 counts, a 1-volt level equals 1000 counts, etc. This feature is not available on Model 8921A.

Accuracy

Fluke Digital Voltmeters avoid the possibilities for error so common in analog meters. The digital displays eliminate the likelihood of misreading the meter due to viewing angle problems of parallax common with analog meters. Also, the accuracy of 8920-Series Voltmeters is specified as a percent of reading rather than as percent of full scale.

Percent of reading accuracy does not degrade for measurements at the low end of a scale. Front panel switching offers a choice of readings in dB or volts.

Specifications

The accuracy specifications below apply from 9% to 100% of full scale and from 18°C to 28°C for 90 days. For six-month specifications multiply figures by 1.5.

AC Accuracy: ± % of voltage reading or ±dB (8920A/8921A)

<table>
<tr><th>Range</th><th>2Hz</th><th>10Hz</th><th>20 Hz</th><th>50 Hz</th><th>10 kHz</th><th>200 kHz</th><th>1 MHz</th><th>2 MHz</th><th>10 MHz</th><th>20 MHz</th></tr>
<tr><td>700V
200V</td><td rowspan="4">Not Specified</td><td rowspan="4">5% or 0.5 dB</td><td rowspan="2">1% or 0.15 dB</td><td colspan="2" rowspan="2">0.5% or 0.1 dB</td><td rowspan="2">0.7% or 0.15 dB</td><td colspan="4">Not Specified</td></tr>
<tr><td>20V
2V
200 mV</td><td colspan="2">3% or 0.35 dB</td><td rowspan="2">5% or 0.5 dB</td><td></td></tr>
<tr><td>20 mV</td><td>2% or 0.25 dB</td><td colspan="2">1% or 0.15 dB</td><td>2% or 0.25 dB</td><td colspan="2">4% or 0.4 dB</td><td></td></tr>
<tr><td>2 mV</td><td>3% or 0.35 dB</td><td colspan="2">2% or 0.25 dB</td><td>3% or 0.35 dB</td><td></td><td></td><td></td><td></td></tr>
</table>

AC Accuracy: ± % of voltage reading or ± dB (8922A)

<table>
<tr><th rowspan="2">Range</th><th>2 Hz</th><th>10 Hz</th><th>20 Hz</th><th>50 Hz</th><th>10 kHz</th><th>200 kHz</th><th>1 MHz</th><th>2 MHz</th><th>11 MHz</th></tr>
<tr><th colspan="4">FILTER IN</th><th colspan="5">FILTER OUT</th></tr>
<tr><td>700V
200V</td><td rowspan="3">3% or* 0.35 dB</td><td>1% or* 0.15 dB</td><td rowspan="2">1% or 0.15 dB</td><td colspan="2" rowspan="2">0.5% or 0.1 dB</td><td rowspan="2">0.7% or 0.15 dB</td><td colspan="3">Not Specified</td></tr>
<tr><td>20V
2V
200 mV</td><td>5% or 0.5 dB</td><td>3% or 0.35 dB</td><td rowspan="3">5% or 0.5 dB</td><td></td></tr>
<tr><td>20 mV</td><td>2% or* 0.25 dB
5% or 0.5 dB</td><td>2% or 0.25 dB</td><td colspan="2">1% or 0.15 dB</td><td>2% or 0.25 dB</td><td></td><td></td></tr>
<tr><td>2 mV</td><td>5% or* 0.5 dB **</td><td>5% or 0.5 dB</td><td>3% or 0.35 dB</td><td>2% or 0.25 dB</td><td colspan="3">4% or 0.4 dB</td><td></td></tr>
</table>

* *Valid when AC + DC DAMPING is selected and input has no dc components.*

** *Below 2 mV add number of digits (N) to ±5% voltage readings, where N = 5 ÷ mV input. Or, for dB readings, add N to ±0.5 dB, where N = 0.05 ÷ (mV input)^2.*

AC+DC Accuracy: Add to AC accuracy specifications (above) ±10 digits or ±0.5 dB above 2 mV, or ±100 digits or ±5.0 dB below 2 mV. For dc only, add above digits to 50 Hz to 10 kHz specifications
Functions: True RMS measurements only. AC or AC + DC (8920A and 8921A); AC or AC + DC with damping (8922A)
Maximum Input: 700V rms or 1000V peak, not to exceed a volt-hertz product of 1 x 10^8 on any range
Maximum Common Mode Voltage
8920A and 8922A: 400 mV rms or 600 mV peak
8921A: 500V rms or 700V peak
AC Common Mode Rejection: ≥60 dB at 50 and 60 Hz with 100Ω unbalance
DC Common Mode Rejection: ≥100 dB, 100Ω unbalance
Crest Factor: 7 at full scale, increasing down scale by 7 times the voltage range divided by the voltage input. Degrades below 10 Hz, annunciated when capability exceeded (8922A only)
Input Impedance: 10 MΩ shunted by <30 pF
Voltage Ranges: 2 mV, 20 mV, 200 mV, 2V, 20V, 200V, 700V
Ranging: Autoranging with HOLD to defeat autoranging and STEP UP for manual ranging. Ranges up at 2000 counts and ranges down at 180 counts
Decibel Ranges: In the autorange mode, the instrument appears as though it has a single range spanning 131 dB
dBm Reference: Twelve user-selectable impedances are provided to reference a 0 dBm, 1 mW level (50Ω, 75Ω, 93Ω, 110Ω, 124Ω, 135Ω, 150Ω, 300Ω, 600Ω, 900Ω, 1000Ω, and 1200Ω) (dBV = 1000Ω)
Relative dB Reference: A voltage input present when this button is pushed is held as "0 dB" reference point. Subsequent readings indicate ±deviations from this point
Voltage Resolution: 0.05% of ranges (3½ digits)
Decibel Resolution: 0.01 dB (4½ digits)
Typical-3 dB Points: 40 MHz on 20 mV thru 20V ranges and 4 MHz on 2 mV range (8920A/8921A); 22 MHz on 2 mV to 20V ranges (8922A)
Low Pass Filter: Approximately 200 kHz -3 dB point, on 8922A only
Reading Rate: 2.5/s or 1/s with ac + dc with damping (8922A)
Autorange Rate: <950 ms or <3.5s with ac + dc with damping (8922A)
Response Time: (To rated accuracy) <1.6s or <7s with ac + dc with damping (8922A)
Readout: Panel-selectable for volts or dB, automatic decimal point location: analog peaking/dipping meter
LED Annunciators: Indicate "mV," "V," "dB," "REL REF," and "2 MHz MAX" for 2 mV range (8920A and 8921A) and "UNCAL" when crest factor limitation exceeded (8922A)
Overrange: Flashes maximum reading for that range
Underrange: Flashes decimal
Linear Analog Output: (8920A and 8922A only) Linear output of 2000 mV dc for a 2000-count readout; ±1.0% relative to display; essentially 0Ω output into a ≥10 kΩ load; non-isolated, with output common same as input common

Option Specifications

Counter Output Option (-03)
Drives frequency counters. Converts input signal into a 100 mV peak square wave. Greater dynamic range extends the sensitivity of counters to 180 μV at the low end and 700V at the high end. Impedance is 50Ω. Used with the 8921A, counter can measure signals elevated to 500V rms.

Logarithmic Analog Output Option (-04)
For 8920A and 8922A only. Provides an analog output voltage proportioned to the logarithm of the input voltage. Plots logarithmically-scaled graphs, dB variations. Zero volts and zero dB on the output correspond with 200 μV on input. A 13.1V output corresponds to 700V or 131 dB on the input. Therefore, 2V on the output equals 20 dB, 6V equals 60 dB, etc., making it easy to relate voltage to dB. The option provides a low-cost way of using an X-Y recorder to plot graphs as one continuous curve over any part of the 131 dB range.

PTI Interface Option (-521)
To use the 8920-Series DVM's with Fluke's own addressable Portable Test Instrument (PTI) byte-serial data bus. Output to Fluke printers, typically. Supplied with 2-foot ribbon cable Y7203.

1120A Interface Option (-522)
A "personality card" that fits in the Fluke 1120A IEEE-488 Translator.

IEEE-488 Interface Option (-529)
The 8920-Series Voltmeters can be made compatible with IEEE Std 488-1978 by using Option -529 in combination with the Fluke Model 1120A Translator. A single 1120A will interface three Fluke instruments to the bus. Option -529 is electrically equivalent to Option -521 plus Option -522.

General Specifications

Temperature: -40°C to +75°C, non-operating
Relative Humidity: <80%
Shock: MIL-T-28800 all classes
Vibration: MIL-T-28800, classes 2, 3 & 4
MTBF: >10,000 hours

Power: 100V, 120V, 220V ac ±10% or 240V ac +4%, -10%, selected by internal switches, 50 to 400 Hz, 10W max
Size: 32.6 cm L x 20.3 cm W x 10.5 cm H (12.9 in L x 8.0 in W x 4.3 in H)
Weight: 2.47 kg (5.44 lb)
Included: Manual, power cord.

Models

January 1986 prices

8920A	DVM, BNC Input, 10 Hz-20 MHz	$1585
8921A	DVM, Banana Jack Input, 10 Hz-20 MHz	1585
8922A	DVM, BNC Input, 2 Hz-11 MHz	1585

Options

892XA-03	Counter Output	220
892XA-04*	Logarithmic Output (not for 8921A)	220
892XA-521	PTI Interface	190
892XA-521K	PTI Interface, field-installable	220
8XXXA-522K	1120A Interface, field-installable	135
892XA-529	IEEE-488 Interface**	275

**Not compatible with -521, -521K, -529*

***The -529 Option can be ordered and installed at time of manufacture only. For existing instruments which do not have -529 Option installed, an IEEE Interface can be added by ordering -521K and -522K (1120A is required).*

Accessories (Also see page 57)

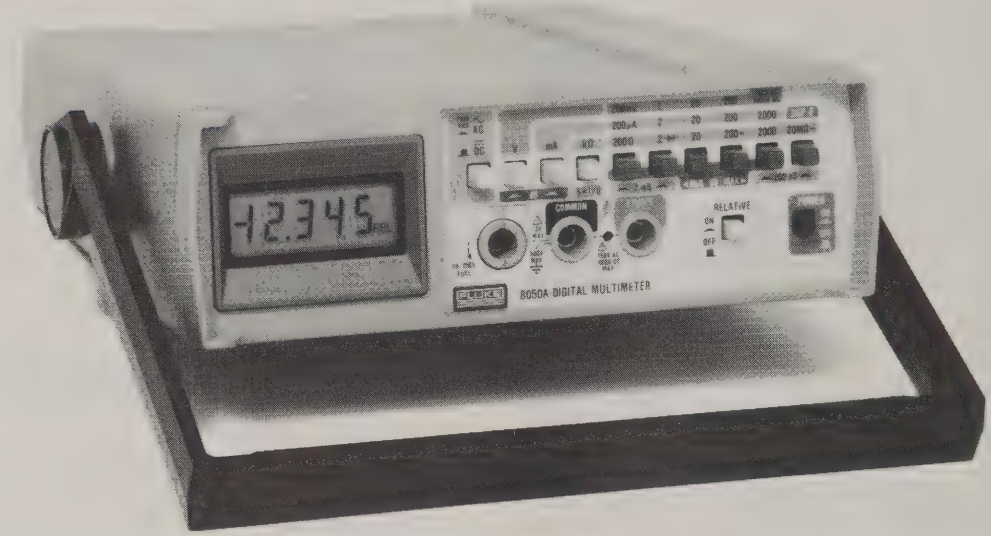
1120A	IEEE-488 Translator	550
Y7203	2 ft PTI Ribbon Cable	50
Y7204	5 ft PTI Ribbon Cable	65
Y2014	5¼″ Rack Adapter, Single	90
Y2015	5¼″ Rack Adapter, Dual	90
Y2020	Panel Mount Kit	90
Y2024	3-Module Power Cord	20
A90	6-Range Current Shunt	595
80J-10	10 Amp Current Shunt	30
Y9103	50 Ohm Feedthrough Terminator	35
Y9107	BNC "T"	15
Y9109	Banana to BNC Adapter	20
Y9111	3-foot BNC to BNC Cable	20
Y9112	6-foot BNC to BNC Cable	20

Also see page 230 for more accessory information.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

8050A . . . Available through Distributors (See page 248)



8050A

8050A, High Performance Value

- 4½ digits (20,000 counts)
- Nine functions including —
  Relative reference, dB, dBm, dBV, dBW (8Ω), Conductance, Diode test
- 0.03% basic dc accuracy
- True-rms from 20 Hz to 50 kHz
- Microcomputer-based
- Extensive overload protection
- Rechargeable battery version (-01)
- Touch-hold probe compatibility (80T-H)
- Probes for rf, high voltage, high current
- Factory Mutual approved

The 8050A provides superior performance and measurement capabilities in a low-cost, benchtop instrument. The 4½-digit DMM has the following measurement functions: Dc volts, true-rms ac volts, dc amps, true-rms ac amps, ohms, dBm (with selectable reference impedances) conductance, and diode test. It also has a relative-reference feature that works with all measurement functions.

Relative Reference

When the RELATIVE switch is on, the displayed value is equal to the difference between the present input value and a previously stored reference value.

One application is to null out test lead resistance. The resistance of the test leads is first measured and stored in the 8050A. Subsequently, all displayed values of resistance will be actual values since the stored value of lead resistance will be automatically subtracted. Measurement errors are greatly reduced for low values of resistance (about 1Ω or less).

Another application is measuring the dB gain of the various stages of an audio amplifier. First, the input voltage to the amplifier is measured and stored as the zero dB reference value. Subsequent measurements will show the gain of each stage of amplification. Calculations are not needed; the 8050's microcomputer does it for you.

The relative-reference feature can be used to determine the drift of power supplies, the bandwidth or bandpass of audio devices, and low-pass filter response. This feature makes the 8050A an excellent pass-fail tester for the production line or incoming inspection.

dB Function

While many analog meters will indicate dBm referenced to 600 ohms, the 8050A provides digital read-out of decibels referenced to any one of sixteen impedances from 8 ohms to 1200 ohms. Now there is no need to use manual conversion tables — the internal microprocessor does the calculations for you. A front panel pushbutton and a scrolling memory lets you select the reference impedance needed.

A resolution of 0.01 dB (above 1 mV) and accuracy specifications from 20 Hz to 50 kHz make the 8050A an extremely valuable tool for audio measurements. It can be used to determine the bandwidth of audio amplifiers, filters, audio consoles, etc. With the addition of an optional rf probe, the 8050A can be used on communications equipment.

Conductance

Two ranges of conductance extend the resistance-measuring capabilities of the 8050A to 100,000 MΩ, far beyond the capacity of ordinary multimeters. This lets you measure leakage of diodes, pcbs, cables, insulators, even measure transistor beta using a simple test adapter.

True-RMS AC

The 8050A uses a true-rms conversion technique to assure accurate measurement of non-sinusoidal waveforms as well as pure sinewaves. Examples: distorted or modulated sinewaves, squarewaves, sawtooths, noise, and pulse trains with a duty cycle of 10% or higher. Specified accuracy extends from 20 Hz to 50 kHz. Useful measurements go to 200 kHz, the typical -3 dB bandwidth.

Optional Touch-Hold Probe

The 80 T-H Probe allows you to "hold" any displayed reading of voltage, resistance, or conductance as long as the control switch on the probe body is depressed. (Not for current or dB measurements.)

Overload Protection

The 8050A has extensive protection against overloads and operator errors. The instrument will accept up to 750V ac or 1000V dc continuously, regardless of the voltage range, or 500V dc when measuring resistance. It will also withstand short-duration transients to 6 kV.

The current input is protected against overloads by an ordinary 2A/250V fuse. For accidental connection of high voltage to the current input terminals (such as 480V ac line power) a heavy duty 3A/600V fuse backs up the first fuse.

Optional Accessories

Fluke offers a complete line of optional accessories that enable you to measure rf voltages to 500 MHz, temperature to 1000°C, current to 600A, or high voltage to 40 kV.

Specifications

All accuracy specifications apply for one year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of 90% or less.

DC Voltage*

Ranges: ±200 mV, ±2V, ±20V, ±200V, and ±1000V
Resolution: 10 µV on lowest range, 0.1V on 1000V range
Accuracy: ±(0.03% of reading + 2 digits) all ranges
Input Impedance: 10 MΩ, ≤100 pF, all ranges
Normal Mode Noise Rejection: ≥60 dB at 50 Hz or 60 Hz
Common Mode Noise Rejection: ≥90 dB at dc, 50 Hz, and 60 Hz with 1 kΩ unbalance
Overload Protection: 1000V dc or peak ac, continuous, except 10 seconds maximum on the 200 mV and 2V ranges
Response Time: 1 second maximum, to rated accuracy within a range

**DC voltage can also be measured using the dB mode with 0.01 dB resolution between 5% of range and full range*

AC Voltage (True-RMS, AC Coupled)

Voltage Readout: From 5% to 100% of range

Range	Resolution	Accuracy: ±(% of Rdg + Digits)				
		20 Hz*–45 Hz	45 Hz–1 kHz	1 kHz–10 kHz	10 kHz–20 kHz	20 kHz–50 kHz
200 mV 2V 20V 200V	10 µV 100 µV 1 mV 10 mV	1% + 10	0.5% + 10		1% + 10	5% + 30
750V	100 mV			Not specified		

**Typically 3 to 5 digits of "rattle" will be observed at 20 Hz at full scale*

dB Readout: From 5% to 100% of range

Input Voltage	dBm 600Ω Ref	Range	Accuracy				
			20 Hz–45 Hz	45 Hz–1 kHz	1 kHz–10 kHz	10 kHz–20 kHz	20 kHz–50 kHz
0.77 mV-2 mV	-60 -52	200 mV*	±0.5 dBm				** N/S
0.1V-2V 1V-20V 10V-200V	-18 +8 +2 +28 +22 +48	2V* 20V 200V	±0.25 dBm	±0.15 dBm		±0.25 dBm	±0.75 dBm
100V-750V	+42 +60	750V			Not specified ** (N/S)		

** When 200 mV range is selected, 8050A autoranges for best accuracy for inputs up to 2V*

dB Resolution: ±0.01 dB from 5% to 100% of range; 0.1 dB from 1% to 5% of range; 1.0 dB below 1% of range
Decibel Reference Impedances: Fifteen user-selectable impedance reference levels are provided to reference a 0 dBm, 1 mW level (50Ω, 75Ω, 93Ω, 110Ω, 125Ω, 135Ω, 150Ω, 250Ω, 300Ω, 500Ω, 600Ω, 800Ω, 900Ω, 1000Ω, 1200Ω). An 8Ω impedance reference level is provided to reference 0 dBW. (dBV = 1000Ω)
Input Impedance: 10 MΩ, ≤100 pF, all ranges
Extended dB Response: Typically -72 dBm (600Ω ref) ±1 dB to 10 kHz
Useful Frequency Range: Typically -3 dB at 200 kHz
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Common Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz with 1 kΩ unbalance
Overload Protection: 750V rms or 1000V peak continuous, except 10 seconds maximum on the 200 mV and 2V ranges, not to exceed a volt-hertz product of 10^7 (e.g., 200V at 50 kHz)
Response Time: 2 seconds max to rated accuracy within a range

DC Current

Range	Resolution	Accuracy (5% to 100% of Range)	Burden Voltage
200 µA 2 mA 20 mA 200 mA	10 nA 100 nA 1 µA 10 µA	±(0.3% of rdg + 2 digits)	0.3V max
2000 mA	100 µA		0.9V max

Overload Protection: 2A/250V and 3A/600V fuse in series

AC Current (True-RMS, AC Coupled)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)*			
		20 Hz**–45 Hz	45 Hz–2 kHz	2 kHz–10 kHz	10 kHz–20 kHz
200 µA 2 mA 20 mA 200 mA	10 nA 100 nA 1 µA 10 µA	2% + 10	1% + 10		2% + 10
2000 mA	100 µA			Not specified	

** 5% to 100% of range*
*** Typically 3 to 5 digits of "rattle" will be observed at 20 Hz at full range*

Burden Voltage: 0.3V rms max, 200 µA through 200 mA range; 0.9V max on 2000 mA range
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Overload Protection: 2A/250V and 3A/600V fuse in series

Resistance

Range	Resolution	Accuracy	Full Scale Voltage
200Ω 2 kΩ*	0.01Ω 0.1Ω	±(0.1% reading +2 digits +0.02Ω)	0.19V 1.2V
20 kΩ 200 kΩ*	1Ω 10Ω	±(0.05% reading +2 digits)	0.2V 2V
2000 kΩ 20 MΩ*	100Ω 1 kΩ	±(0.25% reading +3 digits)	0.2V 2V

**Diode Test ranges*

Diode Test: The three diode test ranges are marked with a diode symbol and have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with the larger diode symbol. The three non-diode test ranges will not turn on silicon junctions when making in-circuit resistance measurements.
Open Circuit Voltage: Less than 3.5V on all ranges
Input Protection: 500V dc or rms ac on all ranges
Response Time: (To rated accuracy) 10 seconds maximum on 20 MΩ range, 2 seconds maximum on all other ranges

Conductance

Range	Resolution	Accuracy
2 mS	0.1 µS	±(0.1% of reading + 5 digits)
200 nS	0.01 nS	±(0.5% of reading + 20 digits)

8050A . . . Available through Distributors (See page 248)

Equivalent Resistance

2 mS Range: 500Ω to 10 MΩ
200 nS Range: 5 MΩ to 100,000 MΩ

Open Circuit Voltage: Less than 3.5V on both ranges
Input Protection: 500V dc or rms ac on all ranges

Relative Reference

An input applied when the RELATIVE button is depressed is held as "0" reference point. Subsequent readings indicate deviations ± from this point

Accuracy: Error will not exceed the sum of the errors for the two measurements

General Specifications

Common Mode Voltage: 500V dc or peak ac max
Temperature: 0°C to 50°C, operating; -40°C to +70°C non-operating, except -40°C to +50°C with batteries
Temperature Coefficient: ≤0.1 times the applicable accuracy specification per °C from 18°C to 0°C and from 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤90% to 35°C, except 2000 kΩ, 20 MΩ, and 200 nS ranges where it is ≤80% to 35°C
Standards: IEC 348, Protection Class I when operated from supply mains or Protection Class II when operated from internal batteries
Power: 90 to 110V ac, 105 or 132V ac, or 200 to 264V ac, 47 to 440 Hz, factory-configured for customer-specified voltage. With rechargeable battery version (-01), the line voltage range is field-changeable. 4W max, 6W max with -01 version.
Batteries: NiCd batteries are installed in version -01. They provide 10 hours of typical operation on a full charge. Recharge takes 14 hours. Can run on ac line while charging.
Size: 22 cm W x 6 cm H x 25 cm L (8.5 in W x 2.5 in H x 10 in L)
Weight: 1.08 kg (2.38 lb) for standard model
Included: Manual, line cord, test leads (Y8132)
and statement of calibration practice

Models

	January 1986 prices
8050A DMM	$389
8050A-01 DMM with rechargeable batteries	439

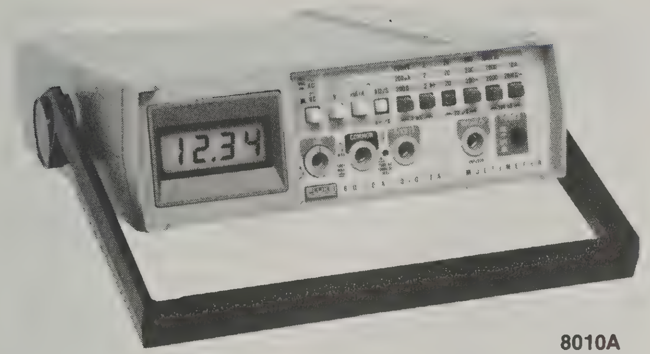
Accessories (Also see page 57)

Y8132 Replacement Test Leads	10
TL70 Test Lead Set	5
Y8134 Deluxe Test Lead Set	20
Y8140 Slim Test Leads, w/needle points	18
Y8205 Soft Carrying Case w/shoulder strap	35
80K-6 High Voltage Probe	45
80K-40 High Voltage Probe	80
83RF 100 MHz RF Probe	49
85RF 500 MHz RF Probe	85
80T-150U Temperature Probe	120
80i-400 AC Current Transformer	69
80i-600 AC Current Transformer	109
Y8100 DC/AC Current Probe	229
Y8101 AC Current Transformer	59
80J-10 Current Shunt	30
80T-H Touch-Hold Probe	45
80TK Thermocouple Module	59
C86 Ruggedized Carrying Case	20
M00-200-611 3½" Rack Adapter, Offset	35
M00-200-612 3½" Rack Adapter, Center	35
M00-200-613 3½" Rack Adapter, Dual	50

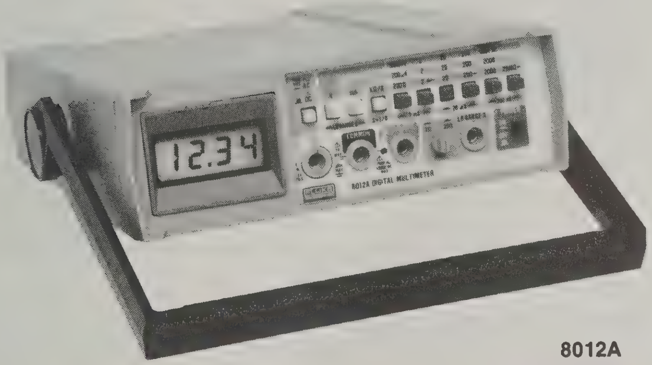
Also see page 230 for more accessory information.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



8010A



8012A

8010A & 8012A Measurement Versatility

- 3½ digits (2000 counts)
- Seven functions, including — Conductance, Diode Test
- 0.1% basic dc accuracy
- True-rms ac, from 45 Hz to 50 kHz
- 10A range (8010A only)
- 2Ω and 20Ω range (8012A only)
- Optional touch-hold probe (80T-H)
- Extensive overload protection
- Rechargeable-battery model (-01)
- Extended measurements with optional accessories
- Factory Mutual approved

The 8010A and 8012A are 3½-digit portable/bench DMMs, that offer exceptional performance and features at a low cost. Measurement functions include: Dc volts, true-rms ac volts, dc amps, true-rms ac amps, ohms, conductance, and diode test. The difference is that only the 8012A features two low-resistance ranges (2 ohms and 20 ohms) and the 8010A features a 10A current range. Rechargeable-battery versions are available as Models 8010A-01 and 8012A-01. The 8010A and 8012A operate on ac line power only.

True-RMS

A Fluke-manufactured true-rms converter assures accurate measurements of non-sinusoidal voltage or current waveforms such as squarewaves (crest factor of 1 to 1). The custom hybrid provides low noise and a wide bandwidth. Accuracy is specified to 50 kHz, but the typical -3 dB bandwidth is 200 kHz.

Conductance

This unique and highly useful function makes resistance measurements as high as 10,000 MΩ possible. Since conductance, which is expressed in Siemens (S), is the inverse of ohms (1/Ω), a simple conversion of the DMMs conductance reading yields resistance. The conductance function is useful for checking high-value resistors, leakage in connectors, cables, printed circuit boards, diodes, photodiodes, etc. Even the beta of a transistor may be measured using a simple adapter.

10A Range (8010A Only)

The 8010A has a 10 ampere ac or dc current range for applications that require measuring more than 2 amperes.

Low Ohms (8012A Only)

The 8012A has two additional ranges of low resistance — 2 ohms and 20 ohms. Along with the conductance function, that gives you a resistance range of 0.001Ω to 10,000 MΩ! There are not many resistance measurements that the 8012A can't handle.

The two low-resistance ranges are suited for measuring transformer windings, cables, heating elements, coils, small-value resistors, and many other devices. Lead resistance is nulled out using a front panel control so that only the unknown resistance is measured.

Optional Touch-Hold Probe

The 80T-H probe lets an operator "hold" the displayed reading by simply depressing a button on the probe's body. The reading will not change until the button is released. The 80T-H can be used as a normal probe at other times. It works for voltage, resistance, and conductance measurements.

Overload Protection

When measuring resistance or conductance, up to 500 volts may be applied with no instrument damage. Voltage inputs can handle 1000V dc or peak ac and transients up to 6 kV. The 2A current input is protected with two in-series fuses — 2A/250V and 3A/600V. In normal overload situations, only the common 2A/250V fuse will blow. The 3A/600V back-up fuse protects the DMM should the 2A/250V fuse ionize when accidentally attached to a source of more than 250 volts — like a 480-volt power line.

Extended Measurements

Optional accessories enable you to extend the measurement capabilities of the 8010A and 8012A. For example, measure current to 600A, rf voltage to 500 MHz, voltage to 40 kV, and temperature to 1000°C (1832°F).

Specifications

All accuracy specifications are for one year after purchase or recalibration when operated in a temperature of 18°C to 28°C

DC Voltage
Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V
Resolution: 100 μV on lowest range, 1V on 1000V range
Accuracy: (±0.1% of reading +1 digit) on all ranges
Input Impedance: 10 MΩ on all ranges
Normal Mode Noise Rejection: ≥60 dB at 60 Hz or 50 Hz
Common Mode Noise Rejection: ≥90 dB at dc, 50 Hz, and 60 Hz, with 1 kΩ unbalance
Overload Protection: To 1000V dc or peak ac on any range
Response Time: 1 second maximum

AC Voltage (True-RMS, AC Coupled)

Range	Resolution	Accuracy: ±(% of Reading + Digits)* 45 Hz	1 kHz	10 kHz	20 kHz	50 kHz
200 mV 2V 20V 200V	100 µV 1 mV 10 mV 100 mV	0.5% + 2		1.0% + 2	5% + 3	
750V	1V	0.5% + 2	Not specified			

Accuracy applies from 5% to 100% of range.

Useful Frequency Range: Typically ±3 dB at 200 kHz
Input Impedance: 10 MΩ in parallel with <100 pF
Common Mode Noise Rejection: ≥60 dB at 50 and 60 Hz with 1 kΩ unbalance
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Overload Protection: To 750V rms, 1000V peak, not to exceed 10^7 volt-hertz product (10 seconds maximum on 200 mV and 2V ranges)
Response Time: 2 seconds maximum

Resistance

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Full Scale Voltage	Max Test Current
2Ω	1 mΩ	1.0% + 2	0.02V	10 mA
20Ω	10 mΩ	0.5% + 2	0.2V	10 mA
Note. . .above ranges in 8012A only				
200Ω	0.1Ω	0.2% + 1	<0.25V	1.30 mA
2 kΩ*	1Ω		>1.0V	1.30 mA
20 kΩ	10Ω		<0.25V	10.0 µA
200 kΩ*	100Ω		<1.0V	35.0 µA
2000 kΩ	1 kΩ	0.5% + 1	<0.25V	0.10 µA
20 MΩ*	10 kΩ		>1.5V	0.35 µA

**Diode Test ranges.*

Diode Test: The three diode test ranges are marked with a diode symbol and have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with the larger diode symbol. The non-diode test ranges will not turn on silicon junctions when making in-circuit resistance measurements.
Open Circuit Voltage: <3.5V on all ranges except <16V on 2Ω and 20Ω ranges
Input Protection: To 300V dc or rms on 2Ω and 20Ω ranges. 500V dc on all other ranges
Response Time: 1 second on all ranges except 2000 kΩ and 20 MΩ where time is 4 seconds, maximum

Conductance

Conductance is the inverse of ohms (1/Ω) and is expressed in Siemens (S), formerly mhos

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Open Circuit Voltage	Max Test Current
2 mS	1 µS	0.2% + 1	<3.5V	1.3 mA
20 µS	10 nS	0.2% + 1	<1.0V	10 µA
200 nS	0.1 nS	1.0% + 10	<1.0V	0.1 µA

Equivalent Resistance
2 mS Range: 500Ω to 1 MΩ
20 µS Range: 50 kΩ to 100 MΩ
200 nS Range: 5 MΩ to 10,000 MΩ
Input Protection: To 500V dc or rms on all ranges

DC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Burden Voltage
200 µA 2 mA 20 mA 200 mA	0.1 µA 1 µA 10 µA 100 µA	0.3% + 1	0.3V max
2000 mA	1 mA		0.9V max
10A*	10 mA	0.5% + 1	0.5V max

**This range in 8010A only*

Overload Protection: 2A, 250V front panel fuse in series with 3A/600V internal fuse. 10 ampere range in 8010A not fused, 12A maximum
Response Time: 1 second maximum

AC Current (True-RMS, AC Coupled)

Range	Accuracy ±(% of Rdg + Digits)* 45 Hz	2 kHz	10 kHz	20 kHz	Burden Voltage
200 µA 2 mA 20 mA 200 mA	1% + 2		2% + 2		0.3V max
2000 mA 10A**	1% + 2	Not specified			0.9V max 0.5V max

**Applies from 5% to 100% of range*
***This range in 8010A only*

Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1
Response Time: 2 seconds maximum
Other Specifications: Same as for dc current

General Specifications

Display: 3½ digit (2000 counts), LCD, autozero, autopolarity
Common Mode Voltage: 500V dc or peak ac, maximum
Touch and Hold: Holds a voltage or resistance reading when the mA jack is momentarily shorted to COMMON. Accessory probe 80T-H is recommended
Temperature: 0°C to +50°C, operating; -40°C to +60°C non-operating, except -40°C to +50°C with batteries
Temperature Coefficient: <0.1 times the applicable accuracy specification per °C, from 18°C to 0°C and 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤90% to 35°C except for 2000 kΩ, 20 MΩ, and 200 nS ranges where it is ≤80% to 35°C
Power: 90 to 132V ac or 200 to 264V ac, 50 or 60 Hz, 2W for standard models. With battery version (-01), voltage and frequency range is selectable with internal switches, 3.5W
Batteries: Rechargeable NiCd batteries and recharge circuits installed in version -01. Recharge time approximately 14 hours. "BT" on display appears when approximately ½ hour of operation remains. Fifteen to thirty hours of operation typical on full charge, depending on functions used
Size: 6 cm H x 22 cm W x 25 cm D (2.5 in H x 8.5 in W x 10 in D)
Weight: 1.08 kg (2.38 lb) for standard models. 1.42 kg (3.13 lb) for version -01 with batteries
Included: Manual, line cord, test leads (Y8132), statement of calibration practice

Models

	January 1986 prices
8010A DMM w/10A Range	$279
8010A-01 DMM w/Batteries	319
8012A DMM w/2Ω and 20Ω Range	359
8012A-01 DMM w/Batteries	399

Accessories (Also see page 57)

Y8131 Replacement Test Leads	10
Y8133 Deluxe Test Lead Set	20
Y8140 Slim Test Leads w/needle points	18
Y8205 Soft Carrying Case	35
80K-6 High Voltage Probe	45
80K-40 High Voltage Probe	80
83RF 100 MHz RF Probe	49
85RF 500 MHz RF Probe	85
80T-H Touch and Hold Probe	45
80T-150U Temperature Probe	120
80TK Thermocouple Module	59
80i-400 AC Current Probe	69
80i-600 AC Current Probe	109
Y8100 DC/AC Current Probe	229
Y8101 AC Current Probe	59
80J-10 Current Shunt	30
C86 Ruggedized Carrying Case	20
M00-200-611 3½" Rack Adapter, Offset	35
M00-200-612 3½" Rack Adapter, Center	35
M00-200-613 3½" Rack Adapter, Dual	50

Also see page 230 for more accessory information.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

THEORY, FEATURES & TERMS

A-to-D Converters

Fluke DMMs employ three different a-d conversion techniques: Dual-slope integration, voltage-to-frequency conversion, and Fluke's patented Recirculating Remainder technique. Each of these techniques provides unique advantages.

The Recirculating Remainder technique features inherent high-speed conversion and short sample time. This is most useful in systems applications where speed is important.

The dual-slope integration technique is used in most portable models. It features almost total rejection of fixed-frequency noise, especially 50 Hz or 60 Hz line noise.

AC Voltage & Current Measurements

Average-sensing ac-to-dc converters are used in some Fluke DMMs and true-rms converter used in others. The average-sensing converter is intended for sinewave measurements where little or no distortion is present. It measures the average value of the rectified sinewave and scales it to provide an rms indication. The true-rms converter is more accurate when the input waveform is not sinusoidal. The Fluke 8506A DMM measures true-rms using a fast thermal transfer technique that improves accuracy by a factor of about 9 to 1 compared to other DMMs.

When measuring ac voltage it is common to use a coupling capacitor to block dc. There is a less common need to measure the rms value of dc and ac combined. Then dc coupling is required unless both are measured separately and combined in a calculation. Use of dc coupling is called the ac+dc mode.

Resistance Measurements

Fluke DMMs utilize both two-wire and four-wire techniques for making resistance measurements. In cases where accuracy requirements are very high and resistance values are less than about 10 kΩ, the four-wire configuration is recommended. This technique eliminates the test-lead resistance from the measured values by providing one pair of terminals for supplying current and a separate pair for sensing voltage.

Glossary

Autopolarity — The polarity of the applied dc voltage or current is automatically indicated.

Autoranging — A mode where the instrument will automatically change to a measurement range that best suits the amplitude of the input signal to be measured.

Autozero — Residual voltage, current, or resistance errors near zero are automatically corrected without a front panel control.

Burden Voltage — Voltage drop across the input terminals when measuring current. Caused by the shunt resistance, fuse resistance, and contact resistance.

Common Mode Noise Rejection — Ability to measure a signal in the presence of an unwanted common mode voltage, typically expressed in decibels. For example, a common mode rejection specification of 120 dB would allow up to 1V of common mode voltage before a 1 μV error would be seen. (120 dB = 1,000,000:1 voltage ratio). Also see Lead Unbalance.

Common Mode Voltage — In DMM terminology, the voltage at the Low terminal of the signal source measured with respect to the power line ground at the multimeter.

Crest Factor — Ratio of the peak value of an ac signal divided by the rms value. Symmetrical square waves have a crest factor of 1:1 and sinewaves 1.4:1. Other waveforms depend on shape and duty factor.

dB — Decibel. A logarithmic unit used to express the magnitude of a change in, or ratio of signals or sound levels. A voltage ratio of 1:10 is equal to -20 dB, and a voltage ratio of 10:1 is equal to 20 dB. It follows that a voltage ratio of 100:1 equals 40 dB, a voltage ratio of 1000:1 equals 60 dB, etc. Because electrical power (P) is proportional to voltage squared (E^2) a *power* ratio of 10:1 is equal to 10 dB not 20 dB.

dBm — Decibel referenced to one milliwatt. A power level equal to ten times the common logarithm of the ratio of a given power (P_x), in watts, to 0.001 watt: $dBm = 10 \log (P_x \div 0.001)$.

Diode Test — A resistance range or special mode that will force a small, forward current through a PN junction, from a supply limited to about 2 volts.

Four-Terminal Ohms — A method for making accurate low resistance measurements where the current-source and voltage-measurement terminals are separate.

Guard — An electrostatic shield used to reduce common mode currents and thereby, in effect, improve common mode rejection.

Lead Unbalance — Usually specified as "1 kΩ in either lead" or "1 kΩ unbalance." A way of stating how different the source impedance must be for each input lead for a common mode signal to be rejected as specified.

MTBF — Mean time between failures, of a repairable product.

Normal Mode Rejection — Ability to measure the dc component of a signal which contains both ac and dc.

Overrange — Capability to measure beyond a range of 1, 10, 100, 1000, etc., without having to change to the next higher range and thereby sacrifice resolution.

Resolution — The magnitude of an input signal equal to a one-digit change in the least significant digit in the display.

Siemens — Unit of conductance (S), formerly mho, the reciprocal of resistance.

Temperature Coefficient — A factor that shows how the ambient temperature may affect accuracy when operated above or below the temperature range where accuracy is specified.

Thermal RMS — A means of measuring the true-rms value of ac using a fast thermal transfer technique.

True-RMS — Capability of accurately measuring the rms value of ac voltages and currents having non-sinusoidal waveforms as well as those having a sinewave form. Also see Crest Factor.

Volt-Herz Product — The numerical result of multiplying the rms value of an ac voltage (volts) by its frequency (hertz). A way of specifying the capability of handling comparatively low voltages at high frequencies or high voltages at low frequencies.

HANDHELD MULTIMETERS

Introduction

Over the past two decades, Digital Multimeters have evolved to become basic and versatile tools of the electronics industry. These troubleshooting devices are used not only to measure volts, ohms, and amps, but, when combined with the wide variety of available accessories, can also measure temperature, rf, high current, and high voltage. Today it is quite common to find DMMs and their accessories in the toolkits of engineers, computer service technicians, TV or appliance repair people, and in the toolkits of hobbyists or homeowners.

Since Fluke's entrance into the DMM market in 1969 our underlying strategy has been to design instruments that provide our customer with:

- Increased performance and reliability
- Reduced size
- Enhanced ruggedness
- Reduced cost

Next in the design process, we incorporate universal convenience features such as autoranging, Touch-Hold, Peak-Hold, Min/Max Hold, and Relative (offset storage) that enhance basic operation.

We then address specific work applications in the most efficient way by making available a variety of accessories.

The selection guide below summarizes the features of Fluke handheld multimeters. Note especially our newest DMMs, the Models 21 and 23. These 3½-digit, 3200 count multimeters combine increased accuracy and the features found in the highly successful Fluke 77 with increased overload protection. See page 42 for the specifications on the Fluke 21 and 23.

Selection Guide

	Basic Features			Special Features							DC Volts**		AC Volts					AC & DC Amps		Ohms, etc.				
Models	Max Display Counts*	Autoranging	Analog Bar Graph	Frequency Measurement	dB, dBm Readout	Offset/Relative Rel	Continuity & Beeper	Peak-Hold, AC/DC	Touch-Hold	Sealed Case Water/Chemical Resistant	Min/Max Hold	Basic Accuracy, %	Max Resolution, µV	Max AC Voltage, w/o Probe (RMS)	True-RMS	Basic Accuracy, %	Max Resolution, µV	Frequency Range, Hz	Max Resolution, nA	Max Amps, w/o Probe	Max Resolution, mΩ	Max Resistance, MΩ	Diode Test	Conductance	Page
Handheld Multimeters																									
Fluke 73	3200	●	●	—	—	—	—	—	—	—	—	0.7	100	750	—	3.0	1k	1k	10M	10	100	32	●	—	36
Fluke 75	3200	(1)	●	—	—	—	●	—	—	—	—	0.5	100	750	—	2.0	1k	1k	10k	10	100	32	●	—	36
Fluke 77	3200	(1)	●	—	—	—	●	—	●	—	—	0.3	100	750	—	2.0	1k	1k	10k	10	100	32	●	—	36
Fluke 21	3200	(1)	●	—	—	—	●	—	—	—	—	0.5	100	750	—	2.0	1k	1k	10k	.32	100	32	●	—	42
Fluke 23	3200	(1)	●	—	—	—	●	—	●	—	—	0.3	100	750	—	2.0	1k	1k	10k	10	100	32	●	—	42
Fluke 25	3200	(1)	●	—	—	—	●	—	●	●	—	0.1	100	1000	—	0.5	100	30k	100	10	100	32	●	●	39
Fluke 27	3200	(1)	●	—	—	●	●	—	●	●	●	0.1	100	1000	—	0.5	100	30k	100	10	100	32	●	●	39
8025A	3200	(1)	●	—	—	—	●	—	●	●	—	0.2	100	1000	—	0.5	100	30k	100	10	100	32	●	●	45
8024B	2000	—	—	—	—	—	●	●	(4)	—	—	0.1	100	750	—	0.75	100	5k	1k	2	100	20	●	●	47
8026B	2000	—	—	—	—	—	●	—	—	—	—	0.1	100	750	●	0.5	100	10k	1k	2	100	20	●	●	50
8020B	2000	—	—	—	—	—	●	—	—	—	—	0.1	100	750	—	0.75	100	5k	1k	2	100	20	●	●	50
8021B	2000	—	—	—	—	—	●	—	—	—	—	0.25	100	750	—	1.0	100	450	1k	2	100	20	●	—	52
8060A	20,000	—	—	(2)	●	●	●	—	—	—	—	0.04	10	750	●	0.2	10	100k	10	2	10	300	(3)	●	54
8062A	20,000	—	—	—	—	●	●	—	—	—	—	0.05	10	750	●	0.5	10	30k	10	2	10	300	(3)	—	54

● Standard
— Not applicable
**All displays LCD*
***Max DC Voltage w/o Probe 100V All Handheld DMMs*

(1) Or manual ranging
(2) For frequencies to 200 kHz

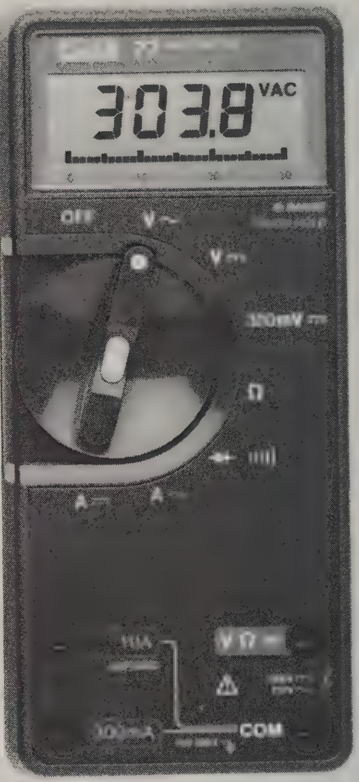
(3) 1 mA constant current mode
(4) Use Peak-Hold Mode

For other multimeters see page 1.

Fluke 73/75/77 Analog/Digital Multimeters . . . Available through Distributors (See page 248)

Fluke 73

Fluke 75



Fluke 77

The Fluke 73

- 3½ digit, 3200 count display
- 32 segment analog bar graph
- 0.7% basic dc accuracy
- Single rotary switch control
- Autoranging selection
- 2000 hours on a single 9-volt battery
- One current range: 10A
- "Sleep Mode" if battery not switched off
- Tough textured case resists grime
- 3 year warranty, 1-year calibration cycle
- UL 1244 listed, VDE listed

The Fluke 75

- 3½ digit, 3200 count display
- 32 segment analog bar graph
- 0.5% basic dc accuracy
- Single rotary switch control
- Autoranging selection
- 2000 hours on a single 9-volt battery
- Three current ranges: 10A, 320 mA, and 32 mA (ideal for 4-20 mA current measurements)
- "Sleep Mode" if battery not switched off
- Tough textured case resists grime
- 3 year warranty, 1-year calibration cycle
- UL 1244 listed, VDE listed

Plus

- Continuity beeper
- "Range Hold" manual range selection

The Fluke 77

- 3½ digit, 3200 count display
- 32 segment analog bar graph
- 0.3% basic dc accuracy
- Single rotary switch control
- Autoranging selection
- 2000 hours on a single 9-volt battery
- Three current ranges: 10A, 320 mA, 32 mA
- "Sleep Mode" if battery not switched off
- Tough textured case resists grime
- 3 year warranty, 1-year calibration cycle
- UL 1244 listed, VDE listed

Plus

- "Touch Hold" (patent pending) to capture readings
- Multipurpose protective holster
- Continuity beeper
- Range Hold

These digital multimeters with analog bar graph display utilize the latest advances in microcircuit technology without compromising quality or capability. The result is a series of meters with features never before found, not even on expensive instruments.

Digital/Analog

The Model 73, 75, and 77 provide a 3200 count digital display that gives extended resolution, and a 32 segment bar graph that reacts 10 times faster than the numerical display, allowing you to make peaking and dipping adjustments easier than with digital-only DMMs.

Autoranging

With autoranging, you choose the function you want and the meter automatically selects the range with the greatest accuracy and resolution. Symbols on the liquid crystal display remind you what is being measured and the range of measurement.

Range Hold

Since repetitive go-no-go tests and peaking/dipping adjustments are more easily done using one range, the manual range function will prove a real boon to users making these tests frequently. Touching the pushbutton once prevents the meter from changing ranges. Pushing the button again changes the range, and holding the button down for a couple of seconds restores the "Autorange" function.

Audible Tones

A continuous audible tone provides a fast check for continuity of current paths having 150 ohms or less.

A brief tone indicates a voltage drop of about 0.6 volts, the normal forward bias for semiconductor devices passing about 500 micro Amps.

Touch Hold

"Touch Hold" captures a reading and displays it from memory even after the probe has been removed from the circuit. As soon as the reading stabilizes, the meter makes a distinctive audible chirp and automatically holds the reading. "Touch Hold" reduces the chance of circuit damage when a probe slips and contacts two points at once because you can concentrate on touching the right test point and nothing else. "Touch Hold" reduces the risk of electrical shock and also gives the user time to log the reading if needed or refer back to the reading before the next measurement.

Multipurpose Holster

Our multipurpose holster is made of a tough resilient plastic that snaps over the instrument, protecting it from even the most severe shock. Both test leads may be snapped into the holster in position so only one hand is needed to hold both the meter and probe tip in contact with the test point. You can also hang the meter on your belt or for easy viewing while probing, tilt it back on its bail for bench use.

Specifications

Accuracy specifications apply for 1 year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90% (80% for 32 MΩ resistance range) unless otherwise noted.

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		
		73	75	77
320 mV 3.2V 32V 320V	0.1 mV 1 mV 10 mV 100 mV	0.7% + 1	0.5% + 1	0.3% + 1
1000V	1V	0.8% + 1	0.6% + 1	0.4% + 1

Input Resistance: 10 MΩ
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB for dc, 50 Hz, and 60 Hz
Overload Protection: 500V dc or rms ac for 320 mV range and 1000V dc or 750V rms ac for other ranges
Response Time: ≤1 second to rated accuracy

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		
		73	75	77
3.2V	1 mV	3% + 2*	2% + 2*	2% + 2*
32V 320V 750V	10 mV 100 mV 1V	3% + 2**	2% + 2**	2% + 2**

* *45 Hz to 500 Hz*
** *45 Hz to 1 kHz*
Typical frequency response is -0.5 dB at 10 kHz on the 32V and 320V ranges and ±3 dB at 5 kHz on the 3.2V and 750V range.

Input Impedance: 10 MΩ and ≤50 pF on all ranges
Common Mode Noise Rejection: ≥60 dB dc to 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc, 750V rms ac
Response Time: ≤2 seconds to rated accuracy

DC Current

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		
		73	75	77
32 mA	0.01 mA	—	1.5% + 2	1.5% + 2
320 mA	0.1 mA	—	2% + 2	2% + 2
10A	10 mA	2% + 2	1.5% + 2	1.5% + 2

Voltage Burden: 0.2V on 32 mA range, 2.0V max. on 320 mA range, 0.5V on 10A range
Input Protection: 630 mA/250V fuse in series with 0.36Ω fusible resistor for 300 mA input; 10A input unfused
Response Time: ≤1 second to rated accuracy

AC Current (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)*		
		73	75	77
32 mA	0.01 mA	—	3% + 2	3% + 2
320 mA	0.1 mA	—		
10A	10 mA	3% + 2		

**45 Hz to 1 kHz*

Voltage Burden: 0.2V on 32 mA range, 2.0V on 320 mA range, 0.5V on 10A range
Input Protection: 0.63A/250V fuse in series with 0.36Ω fusible resistor for 300 mA input; 10A input unfused
Response Time: ≤2 seconds to rated accuracy

Fluke 73/75/77. . . Available through Distributors (See page 248)

Resistance

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		
		73	75	77
320Ω	0.1Ω	1% + 2	0.7% + 2	0.5% + 2
3200Ω 32 kΩ 320 kΩ 3.2 MΩ	1Ω 10Ω 100Ω 1 kΩ	1% + 1	0.7% + 1	0.5% + 1
32 MΩ	10 kΩ	3% + 1	2.5% + 1	2.0% + 1

Open Circuit Voltage: ≤3V
Full Scale Voltage: ≤440 mV on all ranges except ≤1.4V on 32 MΩ range
Input Protection: 500V dc or rms ac
Response Time: ≤1s up to 320 kΩ, ≤2s up to 3.2 MΩ, ≤10s up to 32 MΩ to rated accuracy

Continuity

Threshold: Approximately 150 ohms
Audible Tone: Continuous tone for continuity. Fluke 75 and 77 only.
Display: Less than .100 indicates continuity, OL (overload) indicates open-circuit, approximately 20,000 ohms or higher.
Response Time: Approximately 100 ms

Diode Test

Test Current: Approximately 500 µA for a normal forward biased diode
Audible Tone: Brief tone for normal forward biased diode or semiconductor junction. Fluke 75 and 77 only.
Display: An indication of approximately .600V for a normal forward biased silicon diode or semiconductor function and OL (overload) for a normal reverse biased diode or semiconductor junction
Response Time: Approximately 100 ms

Analog Display

Measurement Rate: 23 measurements per second

"Touch-Hold"

Fluke 77 only. Pushbutton activated mode. Automatically holds stable reading of voltage, resistance, or current indefinitely even if test probe is removed. Reading updated by touching probe to other test points.

General Specifications

Max Common Mode Voltage: 1000V dc or peak ac
Temperature: 0°C to 50°C operating; -40°C to 60°C non-operating
Temperature Coefficient: 0.1 x specified accuracy per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C, ≤90% to 35°C except ≤80% using 32 MΩ range
Safety Rating: Protection Class II per IEC 348, UL and VDE
Power: Single 9V battery, NEDA 1604 9V
Battery Life: More than 2000 hours (alkaline) or 1600 hours (carbon-zinc). "Sleep Mode" extends battery life when you forget to turn power off. Sleep mode activates after approximately 1 hour (15 min in diode test)
Size: 166 mm L x 75 mm W x 28 mm H (6.55 in x 2.95 in x 1.12 in)
Weight: 0.28 kg (0.63 lb)
Included: TL 70 Test Leads, manual, warranty card, plus battery and spare fuse (installed). Also C70 Holster included with Fluke 77.

Models

January 1986 prices

Fluke 73 DMM w/3-year warranty	79
Fluke 75 DMM w/beeper, w/3-year warranty	99
Fluke 77* DMM w/Touch-Hold, w/3-year warranty	139

**Includes C70 Multipurpose Holster*

Accessories (Also see page 230)

C70 Multipurpose Holster	9
C71 Soft Carrying Case	9
TL70 Replacement Test Leads	5
Y8134 Deluxe Test Lead Kit	20
83RF RF Probe	49
85RF RF Probe	85
80K-6 HV Probe	45
80K-40 HV Probe	80
Y8101* AC Current Probe	59
80i-400* AC Current Probe	69
80i-600* AC Current Probe	109
Y8100 DC/AC Current Probe	229
80J-10 Current Shunt	30
80T-150U Temperature Probe	120
80TK Thermocouple Module	59

**Not applicable to Fluke 73*

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

Fluke 25 STD

Fluke 27 STD

Fluke 25 & 27 Analog/Digital & Rugged

- 0.1% basic dc accuracy and 30 kHz ac response
- 3½-digit, 3200 count display
- 31 segment bar graph for peaking, nulling, capacitor checking, and other changing signals
- Auto or manual range selection
- "Touch Hold" to capture and display readings
- Tests insulation resistance to over 10,000 MΩ
- 1000 hour battery life
- Continuity beeper
- LCD symbols annunciate range and modes
- Overload protection including a fused 10A input
- 2 year warranty
- Rugged "O" ring sealed case withstands harsh environments
- Separate sealed battery/fuse door gives easy access
- Superior EMI shielding
- -15° to 55°C operating range
- "Min-Max" Mode stores highest and lowest readings (27 only)
- "Relative Mode" displays only changes in readings (27 only)

Rugged

Plant maintenance electricians, field service technicians, electrical equipment installers, and outside equipment installers will find these instruments rugged, reliable, and easy to use while providing all the accuracy and features needed for almost any application.

Designed to meet military specifications of MIL-T-28800 for Style A, Class 2 Instruments, the Fluke 25 and 27 third generation Analog/Digital Multimeters perform under the extremes of heat, cold, humidity, shock, electromagnetic interference, vibration, and downright abuse.

The Fluke 25 and 27 are built with cases twice as thick as any other DMM we build. The cases are waterproof to 3 feet of water for one hour, resist many industrial chemicals, and won't sustain a flame when put to the blow torch test.

Safe

Electrical and safety protection exceeds the world's toughest safety standards.

Autoranging

With autoranging, you choose the function you want and the meter automatically selects the range with the greatest accuracy and resolution. Symbols on the liquid crystal display remind you what is being measured and the range of measurement.

Fluke 25/27. . . Available through Distributors (See page 248)

Manual Range

Since repetitive go-no-go tests and peaking/dipping adjustments are more easily done using one range, the manual range function will prove a real boon to users making these tests frequently. Touching the pushbutton once prevents the meter from changing ranges. Pushing the button again changes the range, and holding the button down for a couple of seconds restores the "Autorange" function.

Audible Tones

A continuous audible tone provides a fast check for continuity of current paths having 150 ohms or less.

A brief tone indicates a voltage drop of about 0.6 volts, the normal forward bias for semiconductor devices.

Touch Hold

"Touch Hold" captures a reading and displays it from memory even after the probe has been removed from the circuit. As soon as the reading stabilizes, the meter makes a distinctive audible chirp and holds the reading. "Touch Hold" reduces the chance of circuit damage when a probe slips and contacts two points at once because you can concentrate on touching the right test point and nothing else. "Touch Hold" reduces the risk of electrical shock and also gives the user time to log the reading if needed or refer back to the reading before the next measurement.

Min/Max Mode

The 27 can be connected to record minimum and maximum values that will be stored in memory for an extended period, such as over a weekend: useful for monitoring in the absence of chart recorders.

Relative Mode

Often a technician will need to know how much one reading differs from another. By taking the first reading as a reference then pressing the "REL" button, the succeeding measurements will display only the deviation from the reference.

Specifications

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0 mV 3.200V 32.00V 320.0V 1000V	100 μV 1 mV 10 mV 100 mV 1V	0.1% + 1

Input Impedance: 10 MΩ in parallel with <100 pF
Normal Mode Noise Rejection: >60 dB at 50 Hz or 60 Hz
Common Mode Noise Rejection: >120 dB at dc, 50 Hz or 60 Hz; ≤1 kΩ unbalance
Overload Protection V: 1000V rms
Overload Protection mV: 500V rms

AC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		
		40 Hz-2 kHz	2 kHz-10 kHz	10 kHz-30 kHz
320.0 mV 3.200V 32.00V 320.0V	100 μV 1 mV 10 mV 100 mV	0.5% + 3	2% + 3	4% + 10
1000V	1V	1% + 3	3% + 3	Not spec'd.

Input Impedance: 10 MΩ in parallel with <100 pF (ac coupled)
Common Mode Noise Rejection: >60 dB from dc to 60 Hz; ≤1 kΩ unbalance
Overload Protection V ac: 1000V rms (10^7 volt-hertz max)
Overload Protection mV ac: 500V rms (10^7 volt-hertz max)

DC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Typical Burden Voltage
320.0 μA 3200 μA 32.00 mA 320.0 mA 10.00A	0.1 μA 1 μA 0.01 mA 0.1 mA 0.01A	0.75% + 2	0.5 mV/μA 0.5 mV/μA 5.6 mV/mA 5.6 mV/mA 50 mV/A

Input Protection: μA/mA ranges, 630 mA/250V fuse in series with 3A/600V fuse; 10 amp range, 20A/600V fuse

AC Current

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	Typical Burden Voltage
320.0 μA 3200 μA 32.00 μA 320.0 mA 10.00A	0.1 μA 1 μA 0.01 mA 0.1 mA 0.01A	1.5% + 2	0.5 mV/μA 0.5 mV/μA 5.6 mV/mA 5.6 mV/mA 50 mV/A

Overload Protection: Same as DC Current

Resistance

Range	Resolution	Accuracy ±(% of Rdg + Digits)
320.0Ω	0.1Ω	0.3% + 2
3.200 kΩ 32.00 kΩ 320.0 kΩ 3.200 MΩ	1Ω 10Ω 100Ω 1 kΩ	0.2% + 1
32.00 MΩ	10 kΩ	1% + 1

Overload Protection: 500V rms
Open Circuit Test Voltage: <2.8V dc
Full Scale Voltage: Up to 3.2 MΩ <420 mV dc; 32 MΩ <1.3V dc
Conductance: Measures up to 32.00 nS (to 100,000 MΩ) with 0.01 nS resolution accurate to ±1% +10; full scale voltage <1.3V dc

Diode Test/Continuity Test

Overload Protection	Open Circuit Test Voltage	Typical Test Current	Display Voltage
500V rms	<3.3V dc	0.7 mA 0.5 mA 0.3 mA 0.1 mA	0.0V 0.6V 1.2V 2.0V

General Specifications

MIN/MAX Mode (27 only): Records the digital display readings (updated twice per second)
Display: 3½ digits 3200 counts autopolarity, autozero
Common Mode Voltage: 1000V between any terminal and earth ground
Shock, Vibration and Water Resistance: Per MIL-T-28800 Class 2 Style A
Temperature: Storage -55°C to 85°C; Operation -15°C to 55°C
Temperature Coefficient: 0.1 x (specified accuracy) per °C for temperatures <18°C or >28°C
Relative Humidity: 0% to 95% (0°C to 35°C); 0% to 70% (35°C to 55°C)
Power: Single 9V NEDA 1604 or 6F22 or 006P
Battery Life: >1000 hours typical
Battery Indicator: Symbol first displayed when 60 hours of life remain
Safety: Protection Class II per IEC 348 and ANSI C39.5
Size: 2.2 in H x 3.75 in. W x 8 in L (56 mm x 95 mm x 203 mm)

Weight: 1.6 lb (0.75 kg)
C20 Case Size: 4 in. H x 6 in. W x 10.3 in L. (102mm H x 152mm W x 262mm L)
Note: Case is 13 in. (330mm) L including handle
Warranty: 2 years; calibration guaranteed for one year
Includes: Battery, TL70 Test Leads, two insulated alligator clips, spare fuse, and Operator's manual

Available in dark umber (STD model) or yellow (YEL model).

Models

Model	January 1986 prices
Fluke 25 STD Multimeter	$229
Fluke 25 YEL Multimeter	229
Fluke 27 STD Multimeter	259
Fluke 27 YEL Multimeter	259

Accessories (Also see page 57)

C20 Hard Carrying Case	20
C25 Soft Carrying Case	15
TL70 Replacement Test Leads	5
Y8134 Deluxe Test Lead Kit	20
83RF 100 MHz RF Probe	49
85RF 500 MHz RF Probe	85
80K-6 High Voltage Probe	45
80K-40 High Voltage Probe	80
Y8101 AC Current Probe	59
80i-400 AC Current Probe	69
80i-600 AC Current Probe	109
80J-10 Current Shunt	30
80T-150U Temperature Probe	120
80TK Thermocouple Module	59

Also see page 230 for more accessory information.

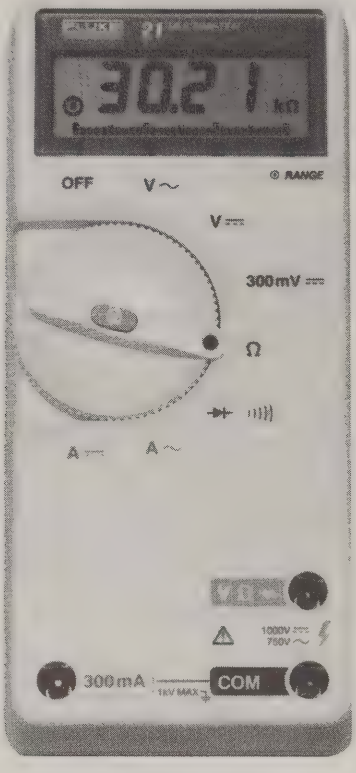
After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

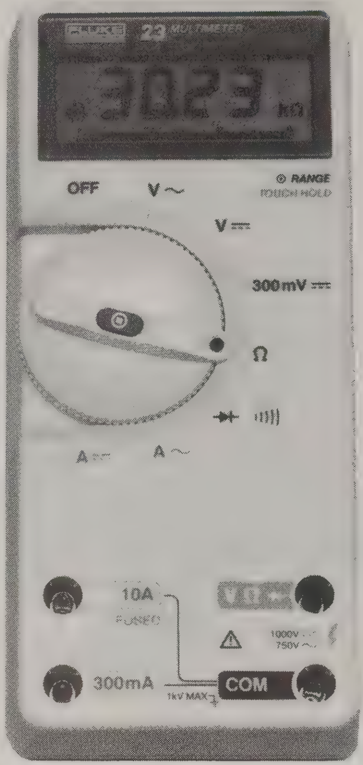
HANDHELD MULTIMETERS

Fluke 21/23 . . . Available through Distributors (See page 248)

NEW



Fluke 21



Fluke 23

Low-Cost, High-Accuracy Multimeters that are High-Energy Protected

- Analog and digital display—tests changing or stable signals
- Easy to use—single rotary switch and automatic ranging
- Volts, ohms, diode test, milliamps, 10 amps (Fluke 23)
- All inputs overload protected, including 10 amps
- Continuity beeper
- High visibility yellow, high impact ABS case
- Touch-Hold™ (Fluke 23)
- 2000 hour battery life on a single 9V battery

The Fluke 21 and 23 are new additions to the Fluke 20 Series of highly accurate, extremely rugged analog/digital multimeters. They offer high-performance and high-energy overload protection in a compact low-cost package.

The rugged ABS plastic case withstands drops and rough handling. The yellow color makes the multimeters easy to find on the job. A single rotary dial with clear, distinct positions selects all functions for simplified operation.

Safety Designed

All inputs on the Fluke 21 and 23 are protected from high energy overloads, including the Fluke 23's fused 10 amp range. Resistance, continuity and mV functions are overload protected to 500 V dc or ac rms, voltage functions to 1000V dc and 750V ac rms. Recessed input jacks accept Fluke safety designed test leads or standard banana plugs.

3200 Count Digital Display

Offers better accuracy and resolution than a conventional 3½ digit (1999 count) DMM. High contrast liquid crystal display, with wide viewing angle, updates two times per second.

31-Segment Analog Bar Graph

Makes dynamic measurements such as peaking, nulling, zero adjustments and capacitor checking. Updates ten times faster than digital readout.

Fast Autoranging and Automatic Polarity

Simplifies and speeds up the use of the meter by instantly selecting the proper range. Optional manual ranging included. Reverse polarity is indicated by a "–" sign next to the reading.

Touch-Hold™ (Fluke 23)

Allows automatic measurements while watching probes and circuit. The meter captures the measurement, beeps, and locks it in the display until you're ready to view it. Automatically updates with each new measurement.

Audible Continuity/Diode Test

Wiring, diode and transistor checks can be done quickly without looking at the display. A continuous tone signals continuity, a beep signals a forward biased diode or transistor.

Standard Equipment

Every meter is packaged with a pair of safety designed Fluke TL70 right angle test leads, two insulated alligator clips, 9V battery, spare fuse and operator's manual. Fluke 23 comes with C70 protective holster that includes tilt bail, belt hook and lead storage. C70 is available as an accessory for Fluke 21.

Specifications

Accuracy specifications apply for 1 year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90% (80% for 32 MΩ resistance range) unless otherwise noted.

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
320 mV 3.2V 32V 320V	0.1 mV 1 mV 10 mV 100 mV	0.5% + 1	0.3% + 1
1000V	1V	0.6% + 1	0.4%+1

Input Resistance: 10 MΩ
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB for dc, 50 Hz, and 60 Hz
Overload Protection: 500V dc or rms ac for 320 mV range and 1000V dc or 750V rms ac for other ranges
Response Time: ≥1 second to rated accuracy

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
3.2 V	1 mV	2% + 2*	2% + 2*
32V 320V 750V	10 mV 100 mV 1V	2% + 2**	2% + 2**

**45 Hz to 500 Hz*
***45 Hz to 1 kHz*
Typical frequency response is -0.5 dB at 10 kHz on the 32V and 320V ranges and ±3 dB at 5 kHz on the 3.2V and 750V range.

Input Impedance: 10 MΩ and ≤50 pF on all ranges
Common Mode Noise Rejection: ≥60 dB dc to 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc, 750V rms ac
Response Time: ≤2 seconds to rated accuracy

DC Current

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
32 mA 320 mA	0.01 mA 0.1 mA	1.5% + 2 2% + 2	1.5% + 2 2% + 2
10A	10 mA	—	1.5% + 2

Voltage Burden: 0.2V on 32 mA range, 2.0V max. on 320 mA range, 0.5V on 10A range
Input Protection: Fluke 21, 630 mA/250V fuse in series with 3A/600V fuse in 300 mA input; Fluke 23, 630 mA/250V fuse in series 0.36Ω fusible resistor for mA input; 20A/600V fuse for 10A input
Response Time: ≤1 second to rated accuracy

AC Current (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)*	
		21	23
32 mA 320 mA	0.01 mA 0.1 mA	3% + 2	3% + 2
10A	10 mA	—	3% + 2

**45 Hz to 1 kHz*

Voltage Burden: 0.2V on 32 mA range, 2.0V max. on 320 mA range, 0.5V on 10A range
Input Protection: Fluke 21, 630 mA/250V fuse in series with 3A/600V fuse in 300 mA input; Fluke 23, 630 mA/250V fuse in series 0.36Ω fusible resistor for mA input; 20A/600V fuse for 10A input
Response Time: ≤2 seconds to rated accuracy

Resistance

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		21	23
320Ω	0.1Ω	0.7% + 2	0.5% + 2
3200Ω 32 kΩ 320 kΩ 3.2 MΩ	1Ω 10Ω 100Ω 1 kΩ	0.7% + 1	0.5% + 1
32 MΩ	10 kΩ	2.5% + 1	2.0% + 1

Open Circuit Voltage: ≤3V

Full Scale Voltage: ≤440 mV on all ranges except ≤1.4V on 32 MΩ range
Input Protection: 500V dc or rms ac
Response Time: ≤1s up to 320 kΩ, ≤2s up to 3.2 MΩ, ≤10s up to 32 MΩ to rated accuracy

Continuity

Threshold: Approximately 150 ohms
Audible Tone: Continuous tone for continuity
Display: Less than .100 indicates continuity, OL (overload) indicates open-circuit, approximately 20,000 ohms or higher.
Response Time: Approximately 100 ms

Diode Test

Test Current: Approximately 500 μA for a normal forward biased diode
Audible Tone: Brief tone for normal forward biased diode or semiconductor junction
Display: An indication of approximately .600V for a normal forward biased silicon diode or semiconductor function and OL (overload) for a normal reverse biased diode or semiconductor junction
Response Time: Approximately 100 ms

Analog Display

Measurement Rate: 23 measurements per second

"Touch-Hold"

Fluke 23 only. Pushbutton activated mode. Automatically holds stable reading of voltage, resistance, or current indefinitely even if test probe is removed. Reading updated by touching probe to other test points.

General Specifications

Max Common Mode Voltage: 1000V dc or peak ac
Temperature: 0°C to 50°C operating; -40°C to 60°C non-operating
Temperature Coefficient: 0.1 x specified accuracy per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C, ≤90% to 35°C except ≤80% using 32 MΩ range
Safety Rating: Protection Class II per IEC 348, UL and VDE
Power: Single 9V battery, NEDA 1604 9V

HANDHELD MULTIMETERS

Fluke 21/23... Available through Distributors (See page 248)

Battery Life: More than 2000 hours (alkaline) or 1600 hours (carbon-zinc). "Sleep Mode" extends battery life when you forget to turn power off. Sleep mode activates after approximately 1 hour (15 min in diode test)
Size: 166 mm L x 75 mm W x 28 mm H (6.55 in x 2.95 in x 1.12 in)
Weight: 0.28 kg (0.63 lb)
Included: TL 70 Test Leads, manual, warranty card, plus battery and spare fuse (installed).

Models

	January 1986 prices
Fluke 21 DMM w/beeper, w/3-year warranty	99
Fluke 23* DMM w/Touch-Hold, w/3-year warranty	145

**Includes C70 Multipurpose Holster*

Accessories (Also see page 57)

C70 Multipurpose Holster	9
C71 Softcase	9
TL70 Replacement Test Leads	5
Y8134 Deluxe Test Lead Kit	20
83RF RF Probe	49
85RF RF Probe	85
80K-6 HV Probe	45
80K-40 HV Probe	80
Y8101 AC Current Probe	59
80i-400 AC Current Probe	69
80i-600 AC Current Probe	109
Y8100 DC/AC Current Probe	229
80J-10 Current Shunt	30
80T-150U Temperature Probe	120
80TK Thermocouple Module	59

Also see page 230 for more accessory information.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

HANDHELD MULTIMETER

8025A

8025A

8025A Multimeter NSN 6625-01-147-6182

- Designed for MIL-T-28800 Type II, Class 2, Style A requirements
- 3½-digit, 3200 count display
- 31 segment bar graph for peaking, nulling, capacitor checking, and other changing signals
- 0.2% basic dc accuracy
- "Touch Hold" to capture and display readings
- LCD symbols annunciate range and modes
- Safety designed with extensive overload protection, non-metallic case, recessed input jacks
- Rugged sealed construction keeps out dirt, water, and contaminants
- Comes with C20 Ruggedized Hard Case and test leads
- 1000 hour battery life
- One year calibration interval
- Two year warranty
- ”Fast autoranging or manual ranging
- Range hold
- Continuity/diode test beeper

Designed for use in harsh military environments, the 8025A offers the performance and accuracy of a digital multimeter with the speed and dynamic measurement capability of an analog meter. Available through Fluke Sales Offices (see page 243 for listing), the 8025A offers bench instrument performance in a convenient hand-held package.

3200-Count Digital Display

The 8025A 3½-digit (3200 count) display equals the resolution of a 4½-digit meter for readings between 2 and 3.2, 20 and 32, or 2000 and 3200.

The analog bar graph allows quicker, easier testing for erratic or unstable signals. It updates ten times faster than the digital display.

Autoranging

Simplifies and speeds up the use of the meter. No need to decide what range to use or to wait for long range-changing delays. Manual ranging is also included.

Audible Continuity/Diode Test

Wiring, diode, and transistor checks can be done quickly without looking at the display.

Touch Hold

You can take readings of critical circuitry while keeping your eyes on the probes and circuit. Using standard test leads, the 8025A captures your measurement, beeps, locks the reading in the display for viewing, and then automatically updates when a new measurement is taken.

Safety

Safety is designed in with extensive overload protection, high energy fuses, fused 10A range, non-metallic case and bail, recessed input jacks, safety-designed test leads, and no fuses to replace for voltage and resistance overloads.

Low Power Resistance

In-circuit resistance measurements can be made without turning on diodes or transistors.

Specifications

Basic electrical specifications are defined for the temperature range of 18°C to 28°C and relative humidity up to 95%, for one year after calibration.

Display

Liquid crystal
Digital Display: 3200 counts plus polarity indication, updated 2 times per second
Analog Display: 31 segment bar graph plus polarity indication, updated 25 times per second
Annunciators: k, M, Ω (Ohms); (Hold); (low battery); (manual range); 3, 30, 300 (range indicators); nS (nanosiemens)

DC Voltage

Range	Resolution	Accuracy: ±(% of Rdg + Digits)
320.0 mV	100 μV	0.2% + 1
3.200V	1 mV	
32.00V	10 mV	
320.0V	100 mV	
1000V	1V	

Input Impedance: 10 MΩ nominal
Normal Mode Noise Rejection: >60 dB at 50 Hz and 60 Hz

HANDHELD MULTIMETER

8025A

Common Mode Noise Rejection: >120 dB at dc, 50 Hz and 60 Hz; ≤1 kΩ unbalance
Overload Protection: 1000V rms; 500V rms on 320 mV range

AC Voltage

Range	Resolution	Accuracy: ±(% of Rdg & Digits)		
		40 Hz-2 kHz	2 kHz-10 kHz	10 kHz-30 kHz
320.0 mV	100 µV	0.5% + 3	2% + 3	4% + 10
3.200V	1 mV			
32.00V	10 mV			
320.0V	100 mV			
1000V	1V	1% + 3	3% + 3	Not spec'd.

Conversion Type: AC coupled, average sensing, calibrated to read rms value of sinewave
Input Impedance: 10 MΩ nominal in parallel with <100 pF
Common Mode Rejection Ratio: >60 dB, DC to 50 Hz, ≤1 kΩ unbalance
Overload Protection: 1000V rms, 500V rms on 320 mV range; 10^7 volt-hertz maximum

DC and AC Current

Range	Resolution	Typical Burden Voltage	Accuracy: ±(% of Rdg + Digits)	
			DC Accuracy	AC Accuracy 40 Hz to 1 kHz
320.0 µA	0.1 µA	160 mV	0.75% + 2	1.5% + 2
3200 µA	1 µA	1.6V		
32.00 mA	10 µA	180 mV		
320.0 mA	100 µA	1.8V		
10.00A	10 mA	0.5V		

Overload Protection: µA/mA ranges: 630 mA/250V fuse in series with 3A/600V fuse. Amp range: 20A/600V fuse

Resistance

Range	Resolution	Accuracy ±(% of Rdg & Digits)
320.0Ω	0.1Ω	0.3% + 2
3.200k	1Ω	0.2% + 1
32.00k	10Ω	
320.0k	100Ω	
3.200M	1 kΩ	
32.00M	10 kΩ	1% + 1
32.00 nS	0.01 nS	2% + 10

Overload Protection: 500V rms
Full Scale Voltage: <420 mV up to 3.2 MΩ; <1.3V up to 32 MΩ
Open Circuit Voltage: <2.8V (-15°C to 55°C)

Diode Test and Continuity:
Diode Test Indication: Displays voltage drop; 0.5 mA nominal test current at 0.6V; 2.08V full scale
Continuity Indication: Continuous audible tone for test resistance below 150 ohms. Momentary tone for test voltage dropping below 0.7V (typical silicon diode threshold)
Open Circuit Voltage: <3.3V (-15°C to 55°C)
Overload Protection: 500V rms

General Specifications

Maximum Voltage to be applied to any terminal: 1000V with respect to earth ground
Power Requirements: Single 9V battery NEDA 1604
Battery Life: 1000 hours typical. Battery symbol first displayed when at least 60 hours of battery life remain
Instrument Size: 56mm H x 95mm W x 203mm L (2.2 in H x 3.75 in W x 8 in L
C20 Case Size: 102mm H x 152mm W x 262mm L (4 in H x 6 in W x 10.3 L
Note: Case is 330mm L (13 in) including handle
Weight: 8025A alone is 0.75 kg (1.6 lb) with case and accessories 1.5 kg (3.2 lb)
Storage Temperature: -55°C to 85°C
Operating Temperature: -15°C to 55°C; operates to -40°C for 20 minutes when taken from a 20°C environment
Temperature Coefficient: 0.1 x the applicable accuracy specification per °C (for temperatures <18°C or >28°C)
Shock, Vibration, Humidity and Water Resistance: Per MIL-T-28800 for a Style A, Class 2 instrument
Included: Battery, TL70 Test Leads, two insulated alligator clips, Instruction Manual, and C20 Ruggedized Hard Case (includes operator's decal)

Model

January 1986 prices

8025A NSN 6625-01-147-6182 Multimeter	$279

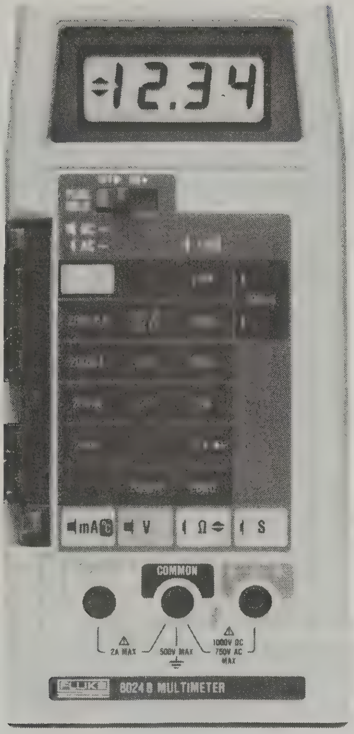
Accessories (Also see page 57)

C25 Soft Carrying Case	15
TL70 Replacement Test Leads	5
Y8134 Deluxe Test Lead Kit	20
80K-6 High Voltage Probe	45
80K-40 High Voltage Probe	80
83RF 100 MHz RF Probe	49
85RF 500 MHz RF Probe	85
Y8101 AC Current Probe	59
80i-400 AC Current Probe	69
80i-600 AC Current Probe	109
Y8100 DC/AC Current Probe	229
80J-10 Current Shunt	30
80T-150U Temperature Probe	120
80TK Thermocouple Module	59

Also see page 230 for more accessory information.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



8024B

8024B More Than a DMM

- 3½ digits (2000 counts)
- High speed audible continuity (50 μs response)
- Peak-Hold
- Temperature (with any K-type thermocouple)
- Logic level detection
- Conductance
- 0.1% basic dc accuracy
- 2-year warranty, 2-year calibration cycle
- Full overload protection
- Fast ac or dc transient capture
- Shock and vibration per MIL-T-28800, Class 5
- Tilt bail with detent position
- UL 1244 listed

Designed with the field service technician in mind, this instrument provides a unique combination of functions that reduces the number of tools needed for on-location repairs. Temperature capability (use any K thermocouple), peak-hold (measure motor starting currents or line transients), and a logic level indicator in combination with features more commonly found on DMMs will make this multimeter an integral part of any customer service tool kit.

The 8024B, like all Fluke handheld DMMs, will withstand the rigors of field service. It is used around the world by people who demand exceptional performance, reliability, and ruggedness.

Continuity Tests

The 8024B indicates circuit continuity in two ways, using either the conductance or resistance ranges. The LCD display shows a ▲ symbol for an open and ▼ for continuity. Also, an audible "beep" will sound when continuity is detected — useful when you cannot see the LCD display. Both types of indicators use a pulse-stretcher circuit so that even momentary shorts or opens as brief as 50 microseconds can be detected.

Peak-Hold

This function works for dc or ac voltage or current measurements and is for capturing transient dc peaks or ac surges. For dc, the most positive value will be displayed on the LCD, and peaks typically as short as 2 ms are captured. Average-sensing, rms-indicating techniques are used for ac for transients as short as 150 ms for 48 to 450 Hz waveforms. The decay-rate of the display is less than one digit per second.

This feature is especially useful for measuring voltage pulses in electro-mechanical equipment or surge currents in electric motors. Currents as high as 600 amps may be measured using the optional current transformer 80i-600 clamp-on ac current probe.

Temperature

The 8024B directly displays temperature (in degrees Celsius) when used with optional K-type thermocouples. The input of the 8024B has a temperature-compensated reference junction.

Temperatures from -20°C to +1265°C can be measured depending on the K-type thermocouple used. The Y8102 is a sheathed probe, good to +925°C, for liquid immersion or penetration measurements. The Y8103 is a bead thermocouple, good to +260°C, for air or gas temperature measurements. The Y8104 is a termination kit for attaching any K-type thermocouple to the 8024B.

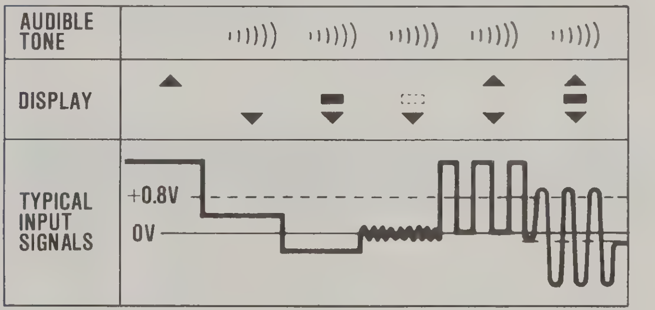
Now you can measure component heat rise, motor temperatures, heating and cooling equipment, etc.

Fluke's high-resolution semiconductor temperature probe, the 80T-150U, will also work with the 8024B as well as all other Fluke DMMs. It has better resolution and accuracy but covers a smaller temperature range (to +150°C or +302°F). The 80T-150U is suited for surface, air, and some liquid immersions.

Logic Level Detection

This function serves the same purpose as an oscilloscope or logic probe in detecting level transitions that last 50 microseconds or longer.

A pulse stretcher is used to detect low-duty-cycle pulses.



Conductance

This unique Fluke feature enables the user to make high resistance measurements, up to 10,000 MΩ. Conductance is useful for testing high value resistors, leakage in cables, diodes, printed circuit boards, and connectors.

Other Features

Fluke engineers have designed extensive protective circuitry into the 8024B so that it will not be damaged by accidental overloads or operator errors.

The 8024B has a 2-year calibration cycle and is covered by a 2-year

8024B. . .Available through Distributors (See page 248)

warranty on parts and labor. If service is required, there are Fluke authorized service centers around the world to help you.

You can expand the measurement capabilities of the 8024B with optional accessories.

Specifications

All accuracy specifications apply for two years after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90%, unless otherwise noted.

DC Voltage

Range	Resolution	Accuracy
200 mV	100 μV	±(0.1% of reading + 1 digit)
2V	1 mV	
20V	10 mV	
200V	0.1V	
1000V	1V	

Input Impedance: 10 MΩ on all ranges
Normal Mode Noise Rejection: ≥60 dB at 50 and 60 Hz
Common Mode Noise Rejection: 100 dB at dc, 50 Hz, and 60 Hz with 1 kΩ unbalance
Overload Protection: 1000V dc or peak ac on all ranges except 15 seconds max on 200 mV range above 300V dc or rms ac
Response Time: ≤1s, all ranges

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy: ±(% of Rdg + Digits		
		45 Hz to 1 kHz	1 kHz to 2 kHz	2 kHz to 5 kHz
200 mV	100 μV	0.75% + 2	1.5% + 3	5% + 5
2V	1 mV			
20V	10 mV			
200V	100 mV			
750V	1V	1% + 2	Not Specified	Not Specified

Conversion: Calibrated for rms value of sinewaves
Input Impedance: 10 MΩ on all ranges, ≤100 pF
Common Mode Noise Rejection: >60 dB at 50 Hz, 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc or 750V rms on all ranges except 200 mV ac range is 15 seconds maximum above 300V ac
Response Time: ≤2s, all ranges

Resistance

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Full-Scale Voltage	Max Test Current
200Ω	0.1Ω	0.2% + 3	≤0.25V	0.35 mA
2 kΩ*	1Ω	0.1% + 1	≥1.0V	1.1 mA
20 kΩ	10Ω		≤0.25V	13 μA
200 kΩ*	100Ω		≥0.7V	13 μA
2000 kΩ	1 kΩ	0.15% + 1	≤0.25V	0.13 μA
20 MΩ*	10 kΩ	2% + 1	≥0.7V	0.13 μA

**Diode Test ranges*

Diode Test: The three diode test ranges are marked with a diode symbol and have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with a large diode symbol. The three non-diode test ranges will not turn on silicon junctions when making in-circuit resistance measurements.
Open Circuit Voltage: Less than 1.5V on all ranges, except 2 kΩ range is less than 3.5V
Input Protection: 500V dc or rms on all ranges; 15 seconds maximum above 300V dc or rms ac

Conductance

Conductance is the inverse of ohms (1/Ω) and is expressed in Siemens (S), formerly mhos. A decrease in conductance is the same as an increase in resistance.

Range*	Resolution	Accuracy ±(% of Rdg + Digits)	Open Circuit Voltage	Max Test Current
200 nS	0.1 nS	2% + 10	<1.5V	0.13 μA

**Equivalent to 5 MΩ to 10,000 MΩ*

Input Protection: To 500V dc or rms ac; 15 seconds maximum above 300V dc or rms ac

DC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Burden Voltage
2 mA	1 μA	0.75% + 1	0.3V max
20 mA	10 μA		
200 mA	100 μA		
2000 mA	1 mA		0.9V max

Input Protection: 2A/250V fuse in series with 3A/600V fuse
Response Time: ≤1 second, all ranges

AC Current (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy ±(% of Rdg + Digits)		Burden Voltage (RMS)
		45 Hz to 450 Hz	450 Hz to 1 kHz	
2 mA	1 μA	3% + 2	Not Spec'd	0.25V max
20 mA	10 μA	1.5% + 2		
200 mA	100 μA			0.9V max
2000 mA	1 mA			

Overload Protection: 2A/250V and 3A/600V fuse in series
Response Time: ≤2 s, all ranges

Peak-Hold

Functions: Dc or ac voltage, dc or ac current, all ranges
DC Accuracy: ±(3% of reading +10 digits) square positive pulses of ≥10 ms duration (2 ms typical)
AC Accuracy: 48 Hz to 450 Hz, ≥150 ms surge duration, ±(3% of reading +10 digits) all ranges, except ±(6% of reading +10 digits) on 2 mA range. Average-sensing, calibrated to read highest rms value of sinewave
Display Decay Rate: ≤1 digit per second

Temperature

Sensor: K-type thermocouple (optional, not included)
Range: -20°C to +1265°C, depending on model of thermocouple
Resolution: 1°C
Accuracy: ±(3°C +1digit) from -20°C to ±300°C and ±3% of reading from 300°C to 1265°C. Accuracy includes NBS curve conformity, calibration, stability, zero, and reference junction, but excludes thermocouple errors
Input Connections: Banana jacks (COMMON and mA °C) which are reference junction temperature compensated. Fluke K-type thermocouples have dual banana plugs. For any other K-type thermocouples or thermocouple wire, use Y8104 terminations
Overload Protection: 2A/250V and 3A/600V fuse in series

Continuity

Ranges: Conductance range and all resistance ranges
Indication: "▲" for open circuit. "▼" for continuity, plus switch-selectable 2 kHz audio tone

Response Time: (2 kΩ range) 50 μs minimum duration of continuity or open to toggle display and/or audible tone. A pulse-stretcher circuit holds display and produces or interrupts tone for approximately 100 ms when short duration continuity or opens occur
Input Protection: 500V dc or rms ac all ranges; 15 seconds maximum above 300V dc or rms ac

Level Detection

Reference Level: +0.8V dc, nominal
Display: "▲" for inputs above reference, "▼" for inputs below reference, both for inputs continually crossing reference level. Switch-selectable audio tone coincident with "▼"
Pulse Response Time: (200 kΩ range) ≥50 μs for 0 to +3V pulse to toggle display. Pulse stretcher holds display for approximately 100 ms when short pulses are detected
Input Impedance: ≥100 kΩ, ≤100 pF
Overload Protection: 500V dc or rms ac; 15 seconds maximum above 300V dc or rms ac

General Specifications

Display: 3½ digits (2000 counts), LCD, autozero, autopolarity
Common Mode Voltage: 500V dc or rms ac, max
Shock and Vibration: Per MIL-T-28800, Class 5
Temperature: 0°C to 50°C, operating; -35°C to +60°C, non-operating
Temperature Coefficient: <0.1 x the applicable accuracy specification, per °C from 18°C to 0°C and 28°C to 50°C, except temperature function is <0.02 x accuracy per °C
Relative Humidity: ≤90% to 35°C, except ≤80% to 35°C on 2 MΩ, 20 MΩ, and 200 nS ranges; ≤70% to 50°C
Power: Single 9V battery, NEDA 1604
Battery Life: Alkaline, 100 hours typical
Battery Indicator: "BT" on display lights when approximately 20% of life remains
Size: 180 mm L x 86 mm W x 45 mm H (7.1 in L x 3.4 in W x 1.8 in H)
Weight: 0.48 kg (1.05 lb)
Included: Manual, test leads (Y8132), 9V battery, operator's card, spare fuse, Statement of Calibration Practice

Model

	January 1986 prices
8024B DMM	$249

Accessories (Also see page 57)

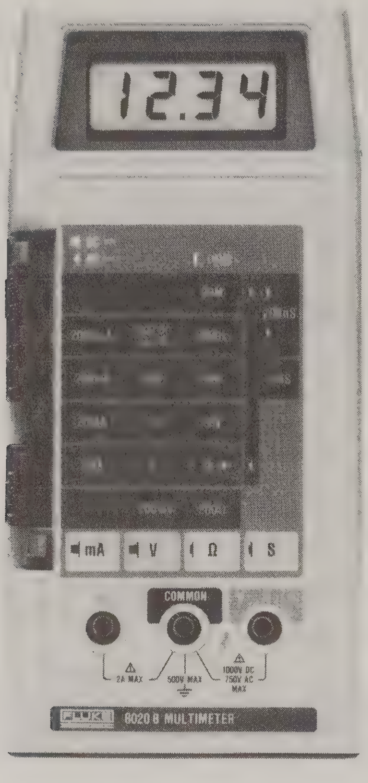
Y8132 Replacement Test Leads	10
Y8134 Deluxe Test Lead Set	20
Y8140 Slim Test Leads, w/needle points	18
80K-6 High Voltage Probe	45
80K-40 High Voltage Probe	80
83RF 100 MHz RF Probe	49
85RF 500 MHz RF Probe	85
80T-150U Temperature Probe	120
80TK Thermocouple Module	59
Y8102 Sheathed Thermocouple	60
Y8103 Bead Thermocouple	25
Y8104 Thermocouple Termination	10
80T-SP Thermocouple Surface Temperature Probe	95
80i-400 AC Current Probe	69
80i-600 AC Current Probe	109
Y8100 DC/AC Current Probe	229
Y8101 AC Current Probe	59
A81 Battery Charger/Eliminator	20
C90 Carrying Case	10
Y8105 Ruggedized Carrying Case	20

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

HANDHELD MULTIMETERS

8026B/8020B . . . Available through Distributors (See page 248)



8020B

8026B and 8020B Professional Precision

- 3½ digits (2000 counts)
- All basic DMM functions
- Conductance
- Diode Test
- True rms (8026B only)
- 0.1% basic dc accuracy
- High-speed audible continuity testing (beeper)
- Bail with detent position
- Extensive overload protection
- UL 1244 listed
- Shock and vibration per MIL-T-28800, Class 5
- Two year warranty
- Extended measurements with optional accessories

Both the 8026B and 8020B provide features that make them ideal for troubleshooting relays, cables, switches, and for locating intermittent shorts and opens. The 8026B and 8020B offer capabilities that allow you to check leakage current of diodes, cable insulation, connectors, printed circuit boards, etc.

The 8026B and 8020B are equipped with extensive internal protection against overloads, transients to 6 kV, or operator errors. The current input is protected with two in-series fuses — 2A/250V and 3A/600V. In normal overload situations, only the common 2A/250V fuse will blow. The 3A/600V fuse will blow when accidentally attached to a source of more than 250 volts — like a 480-volt power line. Over 20% of the components are devoted exclusively to overload protection.

True RMS

Most ac meters are accurate only when measuring sinewaves. In modern electronic and electrical equipment, however, measurement errors on the order of 20% or more may result from radically non-sinusoidal waveforms such as squarewaves, pulses, or the outputs from silicon controlled rectifiers. True-rms sensing circuits such as found in the 8026B prevent such errors.

Specifications

All accuracy specifications apply for one year after purchase or recalibration (2 years for 8020B) when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90%, unless otherwise noted.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V
Resolution: 100 µV on 200 mV range
Accuracy: ±(0.1% of reading +1 digit), all ranges
Input Impedance: 10 MΩ, all ranges
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥100 dB at dc, 50 Hz, and 60 Hz, with ≤1 kΩ unbalance
Overload Protection: 1000V dc or peak ac on all ranges, except 15 seconds maximum above 300V rms on 200 mV range
Response Time: <1 second

AC Voltage, True-RMS (8026B)

Range	Resolution	Accuracy ±(1% of Rdg + Digits)			
		45 Hz to 1 kHz	1 kHz to 2 kHz	2 kHz to 5 kHz	5 kHz to 10 kHz
200 mV	100 µV	0.5% + 2	0.5% + 2	0.5% + 2	2% + 3
2V 20V	1 mV 10 mV			1% + 3	
200V	0.1V		1% + 2	Not Specified	
750V	1V				

AC Voltage, Average-Sensing, RMS-Indicating (8020B)

Range	Resolution	Accuracy ±(% of Rdg + Digits)		
		45 Hz to 1 kHz	1 kHz to 2 kHz	2 kHz to 5 kHz
200 mV 2V 20V	100 µV 1 mV 10 mV	0.75% + 2	1.5% + 3	5% + 5
200V	0.1V			Not Specified
750V	1V	1% + 2	Not Specified	

Input Impedance: 10 MΩ, ≤100 pF, all ranges
Common Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz, with ≤1 kΩ unbalance
Overload Protection: 1000V dc or 750V rms ac, continuous, except 15 seconds maximum above 300V rms on 200 mV range
Response Time: <2 seconds

Resistance

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Full Scale Voltage	Max Test Current
200 Ω	0.1Ω	0.2% + 3	<0.25V	0.35 mA
2 kΩ* 20 kΩ 200 kΩ*	1Ω 10Ω 100Ω	0.1% + 1	>1.0V <0.25V >0.7V	1.1 mA 13 µA 13 µA
2000 kΩ 20 MΩ*	1 kΩ 10 kΩ	2% + 1	<0.25V >0.7V	0.13 µA 0.13 µA

**Diode test ranges*

Diode Test: The three diode test ranges have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with a diode symbol. The three other ranges will not turn on silicon junctions when making in-circuit resistance measurements
Open Circuit Voltage: Less than 1.5V on all ranges except the 2 kΩ range is 3.5V or less
Overload Protection: 500V dc or rms ac on all ranges, 15 seconds maximum above 300V

Continuity

Resistance Ranges: All. The 2 kΩ range is recommended for lowest resistance threshold
Indication: Audible tone for continuity; no tone for open circuit
Response Time: (2 kΩ range) 50 µs minimum duration of continuity or open to toggle tone on or off. A pulse-stretcher circuit produces or interrupts the tone for about 200 ms when a short duration continuity or open occurs
Overload Protection: 500V dc or rms ac on all ranges, 15 seconds maximum above 300V

DC Current

Range	Resolution	Accuracy	Burden Voltage
2 mA 20 mA 200 mA	1 µA 10 µA 100 µA	±(0.75% of reading + 1 digit)	0.3V max
2000 mA	1 mA		0.9V max

Overload Protection: 2A/250V and 3A/600V fuse in series

AC Current, True-RMS (8026B) Average-Sensing, RMS-Indicating (8020B)

Range	Resolution	Accuracy: ±(% of Rdg + Digits)		Burden Voltage
		45 Hz to 450 Hz	450 Hz to 1 kHz	
2 mA	1 µA	3% + 2	Not Spec'd	0.3V rms max
20 mA 200 mA	10 µA 100 µA	1.5% + 2		
2000 mA	1 mA			0.9V rms max

Overload Protection: 2A/250V and 3A/600V fuse in series

Conductance

Conductance is the inverse of ohms (I/Ω) and is expressed in Siemens (S), formerly mhos. A decrease in conductance is the same as an increase in resistance.

Range	Resolution	Accuracy ±(1% of Rdg + Digits)	Open Circuit Voltage	Max Test Current
2 mS 200 nS	10 µS 0.1 nS	0.2% + 1 2% + 10	<3.5V <1.5V	1.1 mA 0.13 µA

Equivalent Resistance
2 mS Range: 500Ω to 1 MΩ
200 nS Range: 5 MΩ to 10,000 MΩ

General Specifications

Display: 3½ digits (2000 counts), LCD, autozero, autopolarity
Common Mode Voltage: 500V dc or rms ac, maximum
Shock and Vibration: Per MIL-T-28800, Class 5
Temperature Coefficient: <0.1 x the applicable accuracy specification per °C from 18°C to 0°C or 28°C to 50°C
Temperature: 0°C to 50°C, operating; -35°C to +60°C, non-operating
Relative Humidity: ≤90% to 35°C except ≤80% to 35°C on 2 MΩ and 20 MΩ ranges; ≤70% to 50°C
Protection Class 2: Relates solely to insulation and grounding properties defined in IEC 348
Power: Single 9V battery, NEDA 1604
Battery Life: 200 hours typical with alkaline battery; 100 hours typical with zinc-carbon battery
Battery Indicator: "BT" appears on LCD display when approximately 20% of battery life remains
Size: 180 mm L x 86 mm W x 45 mm H (7.1 in L x 3.4 in W x 1.8 in H)
Weight: 0.37 kg (0.82 lb)
Included: Manual, test leads (Y8132), 9V battery, spare 2A fuse, operator's card, Statement of Calibration Practice

Models

	January 1986 prices
8026B DMM w/2-year warranty	$199
8020B DMM w/2-year warranty	199

Accessories (Also see page 57)

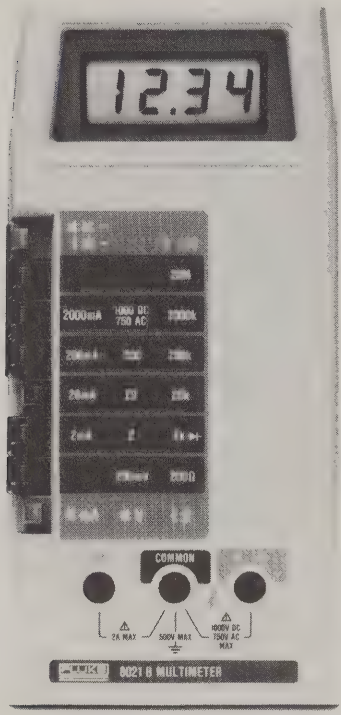
Y8132 Replacement Test Leads	10
Y8134 Deluxe Test Lead Set	20
Y8140 Slim Test Leads, w/needle points	18
80K-6 High Voltage Probe	45
80K-40 High Voltage Probe	80
83RF 100 MHz RF Probe	49
85RF 500 MHz RF Probe	85
80T-150U Temperature Probe	120
80TK Thermocouple Module	59
80i-400 AC Current Probe	69
80i-600 AC Current Probe	109
Y8100 DC/AC Current Probe	229
Y8101 AC Current Probe	59
Y8105 Ruggedized Carrying Case	20
A81 Battery Eliminator	20
C90 Carrying Case	10

Also see page 230 for more accessory information.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

8021B . . . Available through Distributors (See page 248)



8021B

8021B Rugged & Economical

- 3½ digits (2000 counts)
- Six functions including diode test
- Plus high-speed audible continuity
- 0.25% basic dc accuracy
- 2-year warranty, 2-year calibration cycle
- Bail with detent position
- Extensive overload protection
- Ul 1244 listed
- Shock and vibration per MIL-T-28800, Class 5
- Optional accessories for measuring rf, high voltage, high current
- Battery eliminator (A-81) is also available

This rugged 3½-digit handheld DMM was designed for the person who needs the following six basic measurement functions: dc and ac volts, dc and ac amps, ohms, and diode test.

Both electrical and mechanical features make the DMM the world's best in its class. For instance, the 8021B meets the vibration and shock test requirements for Class 5 instruments outlined in U.S. Military Specification MIL-T-28800. Overload protection circuits prevent damage to the instrument caused by accidental operator errors, including voltage input transients up to 6 kV. The current input has two in-series fuses, one for normal overload situations — a common 2A, 250V variety — and a second for high-energy fault conditions, like accidentally connecting the DMM to a 480V ac power line. A crystal-controlled oscillator gives the Fluke handheld DMM the best 60 Hz or 50 Hz line noise rejection available in any handheld DMM.

The simple front panel layout makes the DMM easy to use. A comprehensive owner's manual clearly explains the unit's operation, and typical measurement techniques are covered so you can get the most out of your DMM.

Specifications

All accuracy specifications apply for two years after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 90%, unless otherwise noted.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V
Resolution: 100 μV on 200 mV range
Accuracy: ±(0.25% of reading +1 digit), all ranges
Input Impedance: 10 MΩ, all ranges
Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥100 dB at dc, 50 Hz, and 60 Hz, with ≤1 kΩ unbalance
Overload Protection: 1000V dc or peak ac on all ranges
Response Time: <1 second

AC Voltage (Average-Sensing, RMS-Indicating)

Range	Resolution	Accuracy 45 Hz to 450 Hz
200 mV	100 μV	±(1% of reading + 3 digits)
2V	1 mV	
20V	10 mV	
200V	0.1V	
750V	1V	

Conversion: Calibrated for rms value of sinewaves
Input Impedance: 10 MΩ, ≤100 pF, all ranges
Common Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz, with ≤1 kΩ unbalance
Overload Protection: 1000V dc or 750V rms ac, continuous, except 15 seconds maximum above 300V rms on 200 mV range
Response Time: <2 seconds

Resistance

Range	Resolution	Accuracy ±(% of Rdg + Digits)	Full Scale Voltage	Max Test Current
200 Ω	0.1Ω	0.3% + 3	<0.25V	0.35 mA
2 kΩ*	1Ω	0.2% + 1	>1.0V	1.1 mA
20 kΩ	10Ω		<0.25V	13 μA
200 kΩ*	100Ω		>0.7V	13 μA
2000 kΩ	1 kΩ	2% + 1	<0.25V	0.13 μA
20 MΩ*	10 kΩ		>0.7V	0.13 μA

**Diode test ranges*

Diode Test: The three diode test ranges have enough open circuit voltage to turn on silicon junctions allowing a diode test. The 2 kΩ range is preferred and is marked with a diode symbol. The three other ranges will not turn on silicon junctions when making in-circuit resistance measurements
Open Circuit Voltage: Less than 1.5V on all ranges except 2 kΩ range is 3.5V or less
Input Protection: 500V dc or rms ac on all ranges, 15 seconds maximum above 300V

Continuity

Resistance Ranges: All. The 2 kΩ range is recommended for lowest resistance threshold
Indication: Audible tone for continuity; no tone for open circuit
Response Time: (2 kΩ range) 50 μs minimum duration of continuity or open to toggle tone on or off. A pulse-stretcher circuit produces or interrupts the tone for about 200 ms when a short duration continuity or open occurs
Input Protection: Same as for resistance measurements

DC Current

Range	Resolution	Accuracy	Burden Voltage
2 mA	1 µA	±(0.75% of reading + 1 digit)	0.3V max
20 mA	10 µA		
200 mA	100 µA		
2000 mA	1 mA		0.9V max

Overload Protection: 2A/250V and 3A/600V fuse in series

AC Current

Range	Resolution	Accuracy ±(% of Rdg + Digits)		Burden Voltage (RMS)
		45 Hz to 450 Hz	450 Hz to 1 kHz	
2 mA	1 µA	2% + 2	Not Spec'd	0.3V max
20 mA	10 µA	1.5% + 2		
200 mA	100 µA			
2000 mA	1 mA			0.9V max

Conversion: Calibrated for rms value of sinewaves
Overload Protection: 2A/250V and 3A/600V fuse in series

General Specifications

Display: 3½ digits (2000 counts), LCD, autozero, autopolarity
Common Mode Voltage: 500V dc or rms ac, max
Shock and Vibration: Per MIL-T-28800, Class 5
Temperature: 0°C to 50°C, operating; -35°C to +60°C, non-operating
Temperature Coefficient: <0.1 x the applicable accuracy specification per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤90% to 35°C except ≤80% to 35°C on 2 MΩ and 20 MΩ ranges; ≤70% to 50°C
Protection Class 2: Relates solely to insulation or grounding properties defined in IEC 348
Power: Single 9V battery, NEDA 1604
Battery Life: 200 hours typical with alkaline battery; 100 hours typical with zinc-carbon battery
Battery Indicator: "BT" appears on LCD display when approximately 20% of battery life remains
Size: 180 mm L x 86 mm W x 45 mm H (7.1 in L x 3.4 in W x 1.8 in H)
Weight: 0.37 kg (0.82 lb)
Included: Manual, operator's card, test leads (Y8132), 9V battery, spare fuse, Statement of Calibration Practice

Model

January 1986 prices

8021B DMM w/audible continuity	$159

Accessories (Also see page 57)

Y8132 Replacement Test Leads	10
Y8134 Deluxe Test Lead Set	20
Y8140 Slim Test Leads, w/needle points	18
80K-6 High Voltage Probe	45
80K-40 High Voltage Probe	80
83RF 100 MHz RF Probe	49
85RF 500 MHz RF Probe	85
80T-150U Temperature Probe	120
80TK Thermocouple Module	59
80i-400 AC Current Probe	69
80i-600 AC Current Probe	109
Y8100 DC/AC Current Probe	229
Y8101 AC Current Probe	59
Y8105 Ruggedized Carrying Case	20
A81 Battery Charger/Eliminator	20
C90 Carrying Case	10

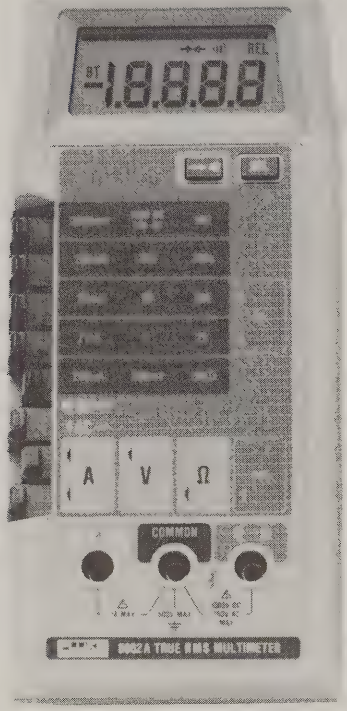
Also see page 230 for more accessory information.

After-Warranty Service (See page 227)

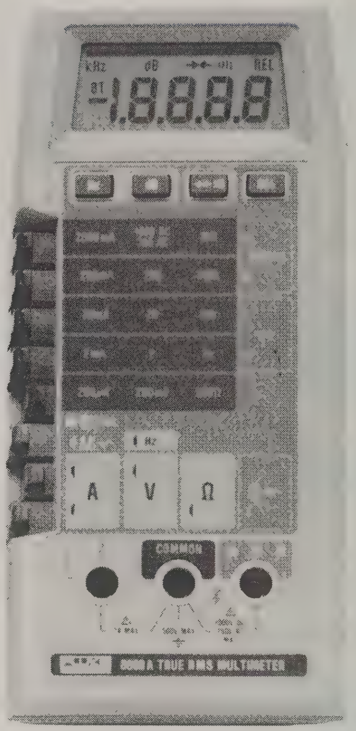
A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

HANDHELD MULTIMETERS

8060A/8062A . . . **Available through Distributors (See page 248)**



8062A



8060A

8062A Precision 4½-Digit DMM

- 4½-digit (20,000 count) resolution
- True-rms ac measurements
- Fast audible/visual continuity tests
- Relative reference (offset)
- Low-power ohms on all resistance ranges
- Constant-current diode test mode
- Measure resistances to 300 MΩ
- True-rms ac voltages to 30 kHz
- 0.05% basic dc accuracy
- Self diagnostics
- UL 1244 listed

8060A World Standard 4½-Digit DMM With Frequency

- 4½-digit (20,000 count) resolution
- True-rms ac measurements
- Fast audible/visual continuity tests
- Relative reference (offset)
- Low-power ohms on all resistance ranges
- Constant-current diode test mode
- Measure resistances to 300 MΩ
- True-rms ac voltages to 100 kHz
- 0.04% basic dc accuracy
- Self diagnostics
- UL 1244 listed

Plus

- *Frequency*. . .12 Hz to 200 kHz functional to 700 kHz
- dBm or relative dB measurements
- Conductance measurements

The 8060A and 8062A 4½-digit handheld DMMs offer more measurement capabilities than found in most bench/portable models. They are Fluke's finest microcomputer-based handheld DMMs offering unique features never before found in a small low-cost DMM. The 8060A even measures *frequency* — from 12 Hz to more than 200 kHz — autoranging over four ranges from 200 Hz to 200 kHz.

At the touch of a single button you can select V, Hz, and dB.

Relative Reference

The microcomputer lets you automatically subtract lead resistance when measuring ohms and display only the difference between a stored reference value and a measured value. The relative mode is great for measuring changes, especially in dB and frequency measurements.

Overload Protected & Rugged

The 8060A and 8062A are well-suited to the needs of engineers and technicians skilled in audio, video, telecommunication, or computer technology. They are designed using the same rugged case and safety engineered jacks, test leads, and double-fused current inputs found on other Fluke handheld DMMs. And the same extensive overload protection is built in for the other functions and ranges.

Automatic MΩ Range Selection

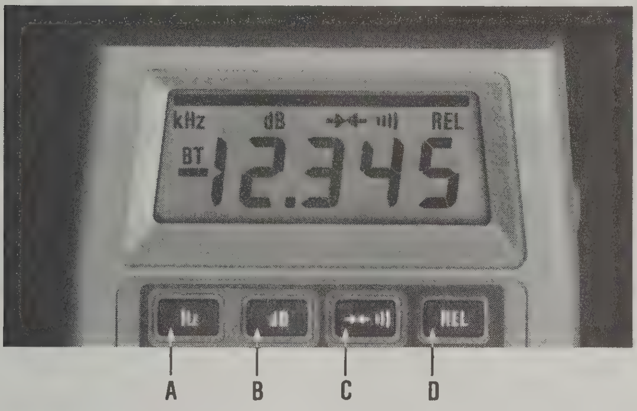
To keep the front panel simple, there is only one manually-selectable position above 200 kΩ. When that position is used, the appropriate 2 MΩ, 20 MΩ, or 300 MΩ range is automatically selected.

Frequency

It is easy to accurately measure the dB gain or loss of amplifiers, filters, attenuators, etc. with a DMM that has dB readout. To combine that feature in a handheld DMM that also measures *frequency* provides a nearly ideal test instrument for many applications. When you need the best in a handheld DMM, you should buy the 8060A. It has features you won't find even in most bench/portable DMMs.

True-rms ac

Because true-rms measurements of ac yield accurate results on non-sinusoidal waveforms as well as sinewaves, the 4½-digit resolution, wide bandwidth, and exceptional accuracy of the 8060A and 8062A make them a superior tool for exacting technical people.



Special Functions

Several special annunciator symbols appear in the display as a reminder of what mode or modes have been selected when pushbuttons **A, B, C,** and **D** are used. Only pushbuttons **C** and **D** and corresponding functions appear on the 8062A.

(A) Pushing the Hz button when in the ac voltage mode selects the frequency function. The best of four ranges (200 Hz, 2 kHz, 20 kHz, and 200 kHz) is then automatically selected for frequencies between 12 Hz and 200 kHz. Readings are updated every 1.3 seconds or less even for low-frequency ranges.

(B) Pushing the dB button converts voltage readings to the equivalent in decibels. The reading may be relative to 1 milliwatt (dBm) across a 600 ohm load, or they may be relative to any level previously stored as a "relative reference."

(C) This pushbutton converts resistance measurements to fast indications of continuity, either audibly with a beep tone or quietly by the appearance of the solid black bar across the top of the display. Continuity as brief as 50 microseconds is enough to be recognized, stored, and indicated.

(D) When you first push the REL button it stores the displayed reading and subsequently subtracts that value from all subsequent readings for that measurement function. REL appears in the display as a reminder until the 8060A or 8062A is turned off or the pushbutton is pressed a second time.

Specifications

All accuracy specifications apply for one year after purchase or recalibration when operated in a temperature of 18°C to 28°C and a relative humidity of up to 80%, unless otherwise noted.

DC Voltage

Ranges: ±200 mV, ±2V, ±20V, ±200V, ±1000V
Resolution: 10 μV on the 200 mV range
Input Impedance: 10 MΩ on all ranges, >1000 MΩ selectable for 200 mV and 2V ranges

Accuracy: ±(% of Rdg + Digits)

Range	8060A	8062A
200 mV, 2V	0.04% + 2*	0.05% + 2
20V, 200V, 1000V	0.05% + 2	0.07% + 2

**Accuracy ±(0.05% of reading + 2 digits) for >1000 MΩ input impedance*

Normal Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz
Common Mode Noise Rejection: ≥120 dB at dc, ≥90 dB at 50 Hz and 60 Hz, with 1 kΩ unbalance
Overload Protection: 1000V dc, 750V rms ac (not to exceed a volt-hertz product of 10^7) on all ranges, continuous except limited to 20 seconds on 200 mV and 2V ranges
Response Time: ≤1 second to rated accuracy

AC Voltage (True-RMS, AC Coupled)

Ranges: 200 mV, 2V, 20V, 200V, 750V
Resolution: 10 μV on the 200 mV range
Input Impedance: 10 MΩ, ≤100 pF (dBm mode also)
Crest Factor: Waveforms with peak/rms ratio of 1:1 to 3:1

Voltage Readout, 8060A: From 5% to 100% of Range

	Accuracy: ±(% of Rdg + Digits)					
Range	20 Hz 45 Hz	45 Hz 1 kHz	1 kHz 10 kHz	10 kHz 30 kHz	30 kHz 50 kHz	50 kHz 100 kHz
200 mV	1%+10	0.2%+10	0.2%+20	0.5%+40	1%+100	3%+200
2V 20V 200V		0.5%+10	0.5%+20	1%+40	2%+100	
750V	Not Spec'd	1%+10	Not Specified			

Voltage Readout, 8062A: From 5% to 100% of Range

	Accuracy: ±(% of Rdg + Digits)				
Range	20 Hz 45 Hz	45 Hz 500 Hz	500 Hz 1 kHz	1 kHz 10 kHz	10 kHz 30 kHz
200 mV 2V	1% + 10	0.5% + 10	0.5% + 20		1% + 40
20V 200V			5% + 20		5% + 40
750V	Not Spec'd	2% + 10		Not Specified	

dBm, 600Ω Reference, 8060A: From 5% to 100% of Range (-50 to +60 dBm)

	Accuracy: ±dB					
Range	20 Hz 45 Hz	45 Hz 1 kHz	1 kHz 10 kHz	10 kHz 30 kHz	30 kHz 50 kHz	50 kHz 100 kHz
2.45 mV- 10.23 mV	±0.5	±1.0		±3.0	Not Specified	
10.24 mV- 19.99 mV	±0.2			±0.5	±1.0	±2.2
20 mV- 199.99V	±0.15			±0.3	±0.65	±1.2
200V- 750V	±0.5		Not Specified			

Useful Frequency Range: -3 dB at 420 kHz at 100% of range, 220 kHz at 5% of range, typical
Common Mode Noise Rejection: ≥60 dB at 50 Hz and 60 Hz, 1 kΩ unbalance
Overload Protection: 1000V dc or peak ac, 750V rms ac (not to exceed a volt-hertz product of 10^7) on all ranges, continuous, except 300V dc or rms ac on the 200 mV and 2V ranges for 20 seconds maximum
Response Time: ≤5 seconds to rated accuracy, any range

8060A/8062A . . . Available through Distributors (See page 248)

DC Current

Range	Resolution	Accuracy: ±(% Rdg + Digits)		Burden Voltage
		8060A	8062A	
200 µA 2 mA	0.01 µA 0.1 µA	0.2% + 2	0.3% + 2	≤0.3V
20 mA	1 µA	0.3% + 2		
200 mA	10 µA		0.7% + 2	
2000 mA	100 µA			≤0.9V

Input Protection: 2A/250V fuse in series with 3A/600V fuse
Response Time: ≤5 seconds to rated accuracy

AC Current (True-RMS)

Has dc-coupled current path, ac-coupled voltage-sensing circuits.
Ranges, Resolution, Burden Voltage: Same as for dc current

Accuracy, 8060A: ±(% of Rdg + Digits)

Range	20 Hz to 45 Hz	45 Hz to 3 kHz	3 kHz to 10 kHz	10 kHz to 30 kHz
200 µA 2 mA 20 mA	1% + 10	0.75% + 10	2% + 20	2% + 40
200 mA				Not Specified
2000 mA			Not Specified	

Accuracy, 8062A: ±(% of Rdg + Digits)

Range	20 Hz to 45 Hz	45 Hz to 3 kHz	3 kHz to 10 kHz	10 kHz to 30 kHz
200 µA 2 mA 20 mA	1% + 10	0.75% + 10	2% + 20	2% + 40
200 mA	1.5% + 10	1% + 10		Not Specified
2000 mA			Not Specified	

Crest Factor: 1:1 to 3:1
Response Time: ≤3 seconds to rated accuracy

Resistance

Ranges: 200Ω, 2 kΩ, 20 kΩ, and 200 kΩ manually selected plus 2 MΩ, 20 MΩ, 100 MΩ, and 300 MΩ automatically selected in the MΩ range

Resolution and Accuracy

Range	Resolution	Accuracy: ±(% of Rdg + Digits)	
		8060A	8062A
200Ω	0.01Ω	0.07% + 2 + 0.02Ω	0.1% + 2 + 0.02Ω
2 kΩ 20 kΩ 200 kΩ	0.1Ω 1Ω 10Ω	0.07% + 2	0.1% + 2
2 MΩ* 20 MΩ* 100 MΩ* 300 MΩ*	100Ω 10 kΩ 100 kΩ 1 MΩ	0.15% + 2 0.2% + 3 1% + 3 2% + 3	0.2% + 2 0.25% + 3 1% + 3 2% + 3

* *These four autoranging MΩ ranges have a high enough source voltage to turn on a silicon junction*

Open Circuit Voltage: ≤2.5V all ranges, except ≤4.8V on 200Ω range
Overload Protection: 500V dc or rms ac on all ranges
Response Time: ≤2 seconds to rated accuracy except ≤8 seconds on MΩ ranges

Continuity

Ranges: All resistance ranges
Threshold: For 8060A, ≤10% of any range used through 200 kΩ range and ≤20 kΩ above 200 kΩ range. For 8062A, ≤50% of range and nominally <100 kΩ above 200 kΩ range.
Indication: Horizontal bar in display, plus audible tone when desired
Response Time: ≤50 µs continuity, ≥200 ms indication

Diode Test

The diode test function displays the voltage-drop across a semiconductor junction using a 1 mA (±10%) constant current supply and a 2V range. All resistance ranges up to and including the 200 kΩ range have less than enough source voltage to forward-bias a semiconductor junction, so that they can be used for in-circuit measurements.
Reading Accuracy: ±(0.05% + 2 digits) for 8060A, ±(0.06% + 2 digits) for 8062A
Overload Protection: 500V dc or rms ac
Response Time: ≤2 seconds to rated accuracy

Conductance (8060A only)

Range: 2000 nS (equivalent to 500 kΩ)
Resolution: 0.1 nS
Accuracy: (0.5% of reading + 20 digits)
Overload Protection: 500V dc or rms ac

Relative Reference

When the REL button is pushed the displayed reading is stored as a reference and subtracted from subsequent readings to indicate the amount of deviation.
Accuracy: Error will not exceed the sum of the errors of the reference reading and subsequent readings

Frequency (8060A only)

Ranges: 200 Hz, 2000 Hz, 20 kHz, and 200 kHz, automatically selected in the Hz mode, ac voltage function. Measures down to 12 Hz. Will measure to 700 kHz in Extended Frequency Mode.
Resolution: 0.005% of range, e.g. 0.01 Hz in 200 Hz range
Accuracy: ±(0.05% of reading + 1 digit)
Input Impedance: Ac coupled into 10 MΩ; <100 pF
Sensitivity: For sinewaves, ≥10% of voltage range to 20 kHz, ≥25% of voltage range to 100 kHz, ≥75% of voltage range to 200 kHz
Response Time: ≤1 second above 16 Hz, ≤1.3 seconds from 12.2 Hz to 16 Hz, to rated accuracy

General Specifications

Calibration Cycle: One-year for specified accuracy
Display: 4½ digits (20,000 counts), LCD, autozero, autopolarity, low battery (BT) indicator
Max. Common Mode Voltage: 500V dc or rms ac
Temperature: 0°C to 50°C operating; -35°C to 60°C non-operating
Temperature Coefficient: ≤0.1 times the applicable accuracy specification per °C from 18°C to 0°C or 28°C to 50°C
Relative Humidity: ≤70% to 50°C or ≤80% to 35°C but ≤70% when measuring resistance above 20 MΩ
Shock and Vibration: Per MIL-T-28800, Class 5
Safety: UL 1244 listed
Power: Single 9V battery, NEDA 1604, typically 170 hours of operation with alkaline type
Size: 180 mm L x 86 mm W x 45 mm H (7.1 in x 3.4 in x 1.8 in)
Weight: 0.41 kg (0.90 lb)
Included: Manual, Y8132 test leads, 9V battery, operator's card, spare fuse, Statement of Calibration Practice

Models

January 1986 prices

8060A DMM, measures frequency	$349
8062A DMM	295

Accessories (Also see page 57)

83RF RF Probe	49
80K-6 High Voltage Probe	45
Y8101 Clamp-on AC Current Probe	59

Also see page 230 for more accessory information.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

MULTIMETER ACCESSORIES

Introduction

Today's multimeters become even more powerful tools through the use of accessories. High voltage or high current probes can scale hazardous voltages and currents to levels safe to measure with a low cost multimeter. High frequency ac rf probes allow the accurate measurement of signals which might otherwise require the use of an expensive oscilloscope. Temperature probes convert temperature readings to millivolts, allowing multimeters to be substituted for dedicated temperature instruments.

Fluke presently offers the broadest range of DMM accessories available from any manufacturer. Although similar accessories are offered by other manufacturers, Fluke accessories are unsurpassed in quality of design and workmanship. Nothing less would be acceptable from the world leader in Digital Multimeters. And our accessories are compatible with other manufacturers' DMMs.

Accessories are an integral part of the Fluke strategy to provide customers with cost effective solutions to a wide range of measurement problems.

Emphasizing this commitment, our newest accessory, the 80i-400 ac current clamp offers exceptional performance at an attractive price. One of four current clamps from Fluke, the 80i-400 incorporates a jaw shape particularly well suited for probing among the congested wires of a typical electrical power panel.

See the selection guide below and the following pages for further information on how accessories can enhance your DMM.

Selection Guide

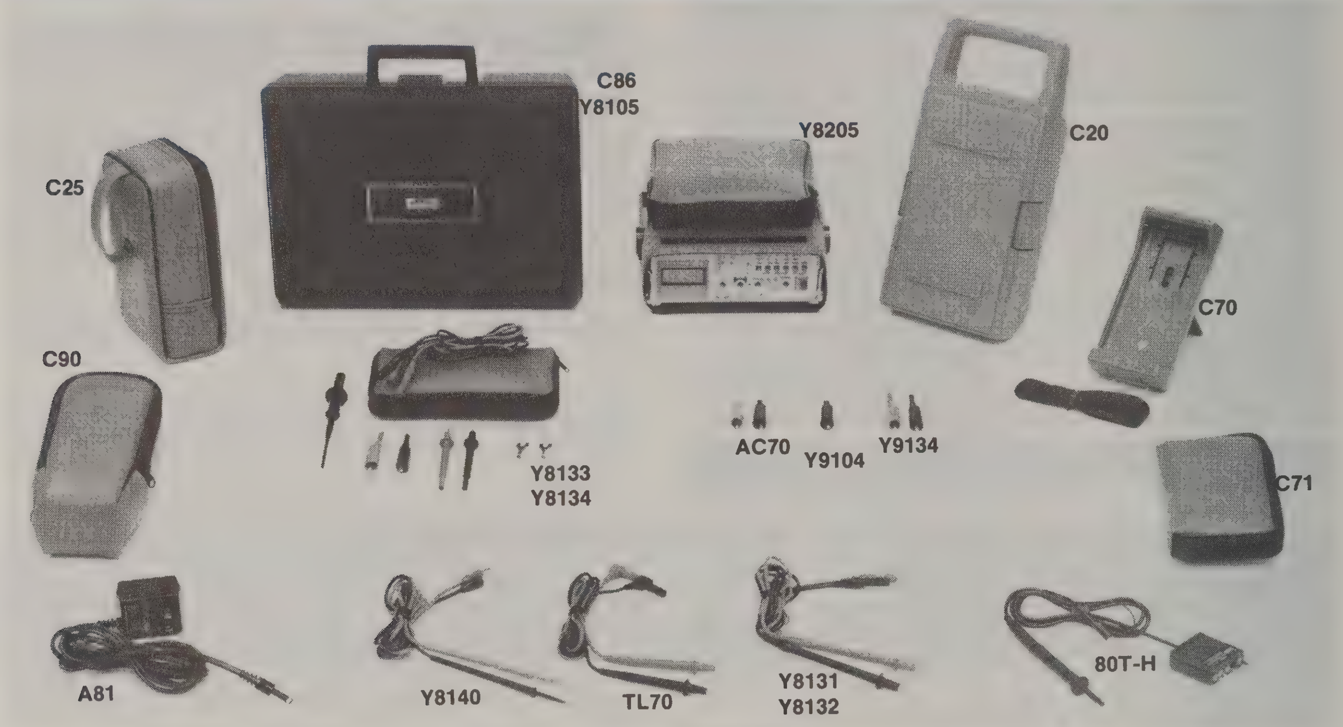
ACCESSORIES	DIGITAL VOLTMETERS and MULTIMETERS																													
	8025A	21	23	25	27	73	75	77	8010A	8012A	8020B	8021B	8024B	8026B	8050A	8060A	8062A	8500A	8502A	8505A	8506A	8520A	8522A	8600A	8810A	8840 Series	8860A	8920A	8921A	8922A
TL70 Test Lead Set	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	—	—	●	●	●	●	●	●	●	—	—	—	—	—	—	—	—	(4)	—	—	—	—
Y8131 Test Lead Set	—	—	—	—	—	—	—	—	(4)	(4)	—	—	—	—	—	—	—	●	●	●	●	●	●	●	●	—	—	(1)	●	(1)
Y8132 Test Lead Set	●	●	●	●	●	●	●	●	—	—	(4)	(4)	(4)	(4)	(4)	(4)	(4)	—	—	—	—	—	—	—	—	●	●	—	—	—
Y8133 Test Lead Set	—	—	—	—	—	—	—	—	●	●	—	—	—	—	—	—	—	●	●	●	●	●	●	●	●	—	—	(1)	●	(1)
Y8134 Test Lead Set	●	●	●	●	●	●	●	●	—	—	●	●	●	●	●	●	●	—	—	—	—	—	—	—	—	●	●	—	—	—
Y8140 Test Lead Set	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(1)	●	(1)
C20 Hard Case	(4)	—	—	●	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C25 Soft Case	●	(6)	(6)	●	●	(6)	(6)	(6)	—	—	●	●	●	●	—	●	●	—	—	—	—	—	—	—	—	—	—	—	—	—
C70 Holster	—	●	(4)	—	—	●	●	(4)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C71 Soft Case	—	●	●	—	—	●	●	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C86 Hard Case	—	—	—	—	—	—	—	—	●	●	—	—	—	—	●	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—
C90 Soft Case	—	(6)	(6)	—	—	(6)	(6)	(6)	—	—	●	●	●	●	—	●	●	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8105 Hard Case	—	—	—	—	—	—	—	—	—	—	●	●	●	●	—	●	●	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8205 Soft Case	—	—	—	—	—	—	—	—	●	●	—	—	—	—	●	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—
A81 Battery Eliminator	—	—	—	—	—	—	—	—	—	—	●	●	●	●	—	●	●	—	—	—	—	—	—	—	—	—	—	—	—	—
80T-H Touch-Hold Probe	(5)	—	(5)	(5)	(5)	—	—	(5)	●	●	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
83RF R.F. Probe	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(1)	●	(1)
85RF R.F. Probe	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(1)	●	(1)
80TK Temp. Module	●	●	●	●	●	●	●	●	●	●	●	●	(5)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(1)	●	(1)
80T-150U Temp. Probe	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(1)	●	(1)
80T-SP Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8102 Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8103 Temp. Probe	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Y8104 Temp. Termination	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80K-6 H.V. Probe	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(1)	●	(1)
80K-40 H.V. Probe	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(1)	●	(1)
80J-10 Current Shunt	—	●	—	—	—	—	—	—	—	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(1)	●	(1)
Y8100 Current Probe	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(1)	●	(1)
Y8101 Current Probe	●	●	●	●	●	—	●	●	●	●	●	●	●	●	●	●	●	(3)	(3)	(3)	(3)	(3)	(3)	●	(3)	●	(3)	(3)	(3)	(3)
80i-400 Current Probe	●	(7)	●	●	●	—	●	●	—	—	●	●	●	●	●	●	●	(3)	(3)	(3)	(3)	(3)	(3)	●	(3)	●	(3)	(3)	(3)	(3)
80i-600 Current Probe	●	(7)	●	●	●	—	●	●	●	●	●	●	●	●	●	●	●	(3)	(3)	(3)	(3)	(3)	(3)	●	(3)	●	(3)	(3)	(3)	(3)
Y9108 BNC Adapter	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	—	●	—
Y9109 BNC Adapter	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—	●

● Means compatible and recommended
— Not compatible, not recommended, or not applicable
(1) Y9109 Adapter required
(2) On some ranges inputs must be shunted to equal 10 MΩ
(3) Current-measuring option required or A90
(4) Included with DMM
(5) Feature of DMM w/o probe
(6) Accomodates DMM with C70 Holster
(7) Compatible, 320A maximum

MULTIMETER ACCESSORIES

Available through Distributors (See page 248)

Convenience accessories simplify circuit connections, probe hard-to-reach places, and protect instruments.



Y8131 Test Lead Set $10

Four-foot test leads feature exposed banana plugs on one end and detachable probes with solid pin tips and finger guards on other end. See Selection Guide for compatible DMMs.

Y8132 Test Lead Set $10

Same as Y8131 except safety designed banana plugs are shrouded by an insulating shield. See Selection Guide for compatible DMMs.

Y8140 Test Lead Set $18

Slim four-foot test leads that have retractable, insulated needle point tips for adjustable lengths. Tough, thin insulation extends all the way to the points to prevent shorting adjacent components or conductors. Needle points easily pierce varnish and thin insulation to give good electrical contact. See Selection Guide for compatible DMMs.

TL70 Test Lead Set $5

Safety-designed right angle plugs shrouded by insulating shield. Strain relief where wire joins probes. See Selection Guide for compatible DMMs.

Y8133 Test Lead Kit $20

Y8133 includes a black and a red insulated wire lead each having an exposed banana plug on one end and a safety-designed, shrouded banana plug on the other. Leads have strain relief for long life. Also included are two insulated alligator clips, two spade lug tips, a spring-loaded hook tip, and two probes with solid metal pin tips and finger guards. Any of the clips, tips, and probes may be plugged onto the shrouded banana plug on either wire lead. See Selection Guide for compatible DMMs.

Y8134 Test Lead Kit $20

Same as Y8133 Test Lead Kit except banana plugs are shrouded by an insulating shield on both ends of each lead. See Selection Guide for compatible DMMs.

Y9134 Alligator Clips $17

Package of ten insulated alligator clips with banana jack. Five red and five black. For Y8131 through Y8134.

Y9104 Alligator Clips $12

Package of six black slip-on insulated alligator clips for ground connections. Compatible with pin-tip size probes except TL70.

AC70 Alligator Clips $5

Package of four slip-on, insulated alligator clips. Two red and two black. Compatible with TL70 or other pin-tip size probes.

Y8205 Soft Carrying Case $35

A soft vinyl plastic container designed for the storage and transport of either an 8000A, 8010A, 8012A, 8050A, or 8600A DMM. A separate storage compartment is provided for test leads and other compact accessories.

C25 Soft Carrying Case $15

Thickly padded vinyl with tough exterior and interior and heavy-duty water resistant zipper. Holds DMM and test leads. Includes combination belt loop/carrying strap and two storage pockets. For Fluke 25/27 and 8025A. Also accomodates small accessories and Fluke 21, 23, 73, 75, 77 Meters in C70 holster.

C71 Soft Carrying Case $9

A soft, zippered vinyl case for Fluke 21, 23, 73, 75, 77 Multimeters when not in the C70 Holster. Includes pocket for test leads.

C90 Soft Carrying Case $10

Constructed of double-wall, fabric-backed vinyl with padded interior and zippered closure for complete protection. Inside pocket holds test leads and operator's instruction card. Carrying strap doubles as belt loop holder. Accommodates 20 and 70 Series DMMs in C70 Holster. For all Fluke handhelds except 25 and 27 DMMs.

C20 Hard Carrying Case $20

The C20 is a heavy duty hard case made of shock resistant hard plastic. A carrying handle, operator's guide decal, and storage compartment for test leads and other small items is included. The cover is secured by two latches that also latch the case top to the back of the case for convenient storage and to form a tilt-up stand. For Fluke 25/27 and included with Fluke 8025A.

C86 Hard Carrying Case $20

The Model C86 Carrying Case is a molded polyethylene container designed for either an 8010A, 8012A, 8000A, 8050A, or 8600A DMM. This rugged case provides the DMM with maximum protection against rough handling and adverse weather conditions. A separate storage compartment is provided for test leads and other compact accessories.

Y8105 Hard Carrying Case $20

A tough, hard plastic case that provides protection against rough handling and bad weather. Will also hold 80i-600, 80i-400 or Y8101 Current Probes and smaller accessories. Resembles C86. See Selection Guide for compatible Handheld Multimeters.

C70 Multipurpose Holster $9

The C70 is for Fluke 21, 73 and 75 Multimeters and is included with the Fluke 23 and 77 models. It is made of a tough semiflexible plastic that snaps over the instrument to absorb shocks and protect the meter from rough handling. The holster also doubles as a tilt stand and includes a belt clip. Holster stores test leads and probes. Probes may be snapped into holster so only one hand is needed to hold both the meter and probe tip in contact with test point.

A81 Battery Eliminator $20

The A81 provides line operation for DMMs without discharging their disposable batteries. Available in three line voltage versions. Specify version desired. See Selection Guide for compatible DMMs.

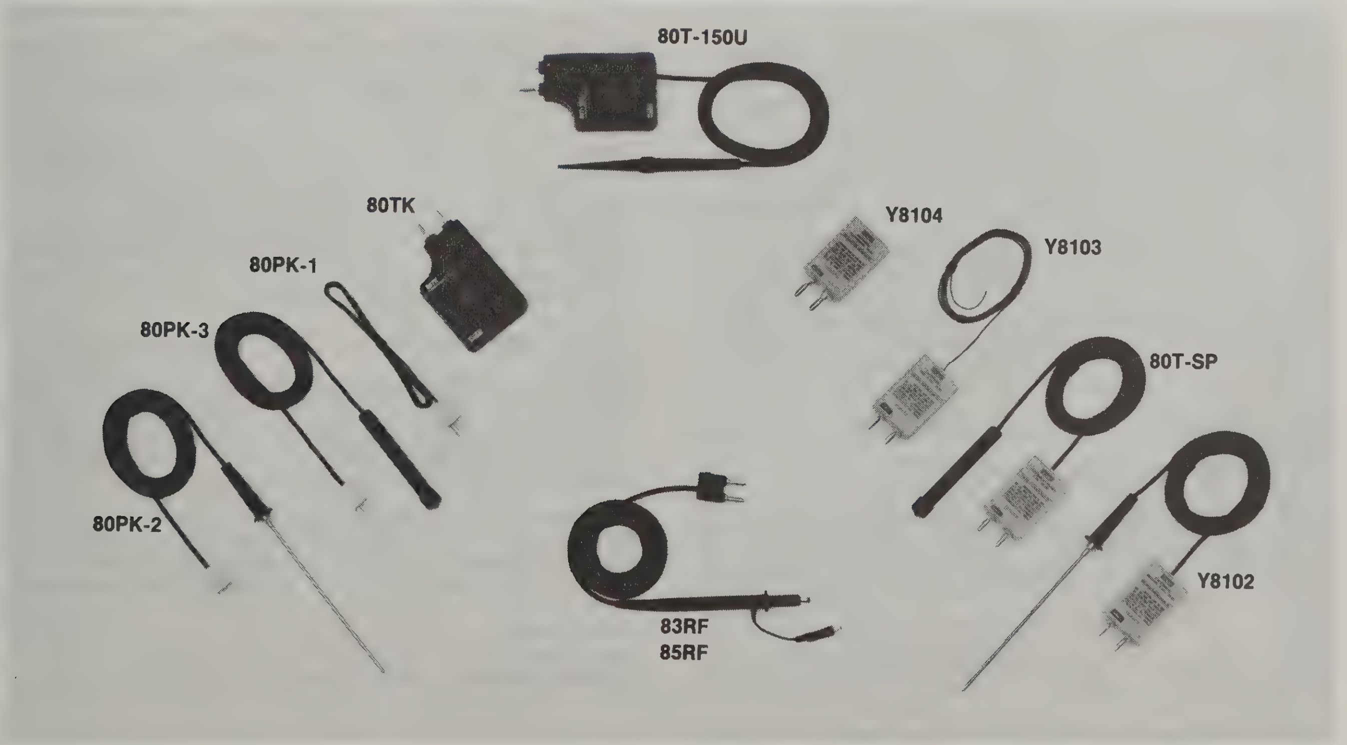
A81-115 115V input (U.S. plug)
A81-230 230V input (European plug)
A81-100 100V input (U.S. plug)

80T-H Touch and Hold Probe $45

The 80T-H is a direct signal-through test probe with a touch and hold feature. Touch-and-hold allows voltage or resistance readings to be held on a digital multimeter display following contact of the probe tip with the test point. Operator can devote full attention to manipulating the probe until the measurement is complete, then remove the probe and observe the reading on the DMM. Activation of a pushbutton on the probe causes the DMM to hold the last number displayed until the pushbutton is released. Works with 8010A, 8012A, 8050A only.

Voltage Rating
Tip to Common: 1000V dc or peak ac maximum
Common to Ground: 60V dc or 42V peak ac maximum
Input Capacitance: 150 pF maximum
Lead Resistance: 0.5Ω maximum

Extend the measurement capabilities of your DMM to include temperature and high-frequency measurements.



MULTIMETER ACCESSORIES

Available through Distributors (See page 248)

83RF High Frequency Probe $49

The 83RF converts a dc voltmeter into a high frequency, 100 kHz to 100 MHz, ac voltmeter. Conversion from ac to dc is on a one-to-one basis over a range of 0.25 to 30V rms. The probe's dc output is calibrated to be equivalent to the rms value of a sinewave input.

AC-to-DC Ratio: 1:1
Ratio Accuracy: ±1 dB above 1V; ±1.5 dB below 1V (at 1 MHz with 10 MΩ load)
Frequency Response: ±1 dB 100 kHz to 100 MHz (relative to 1 MHz)
Extended Frequency Response: Relative readings from 20 kHz to 250 MHz
Response: Responds to peak value of input; calibrated to read rms value of a sinewave
Voltage Range: 0.25 to 30V rms
Maximum Input Voltage: 30V rms, 200V dc
Input Capacitance: Approximately 3 pF

85RF High Frequency Probe $85

The 85RF is designed to convert a dc voltmeter into a high frequency, 100 kHz to 500 MHz, ac voltmeter. Ac to dc conversion ratio is one-to-one over a range of 0.25 to 30V rms. The probes dc output is calibrated to the rms value of a sinewave input.

AC-to-DC Ratio: 1:1
Ratio Accuracy: ±0.5 dB above 0.5V (at 1 MHz with 10 MΩ load) ±1 dB below 0.5V
Frequency Response: ±0.5 dB 100 kHz to 100 MHz; ±1.0 dB 100 MHz to 200 MHz;* ±3.0 dB 200 MHz to 500 MHz* (relative to 1 MHz)
Extended Frequency Response: Relative readings from 20 kHz to 700 MHz
Response: Responds to peak value of input; calibrated to read rms value of a sinewave
Voltage Range: 0.25 to 30V rms
Maximum Input Voltage: 30V rms, 200V dc
Input Capacitance: Approximately 3 pF
**Referred to high and low inputs at probe tip*

80T-150U Universal Temperature Probe $120

The 80T-150U is a universal temperature probe designed to provide virtually all DMMs with temperature measuring capability. Intended for air, surface, and non-corrosive liquids, the probe provides direct temperature conversion of 1 mV dc per degree. A three-position switch on the unit acts as a power switch and is used for selecting Celsius or Fahrenheit scaling for the output. In addition, the OFF position of the power switch allows the battery condition to be determined via the external DMM. Operating power for the 80T-150U is derived from a standard 9 volt battery. Typically, the battery provides more than 1600 hours of continuous operation before replacement is necessary. An outstanding feature of particular importance to electronically-oriented users is the probe's ability to stand off voltages to 350V dc or peak ac. This allows voltages to be present on devices whose temperature is being measured. Resolution is 0.1° on the 200 mV range of a 3½-digit DMM. *Available April 1986. Until April 1986, please specify 80T-150C (°C Celsius) or 80T-150F (°F Fahrenheit).*

Temperature Range: -50°C to +150°C or -58°F to +302°F, cable 70°C maximum
Celsius-Fahrenheit Selection: Switch selected
Sensitivity: 1 mV per °C or °F
Resolution: 0.1°C or 0.1°F recommended maximum
Ambient Temperature Range for Unit: 0°C to +50°C
Relative Humidity: ≤80%, non-condensing
Accuracy: (Including nominal 0.25% voltmeter error, in +15°C to +35°C ambient)

±1°C (1.8°F) 0°C to 100°C, decreasing linearly to ±3°C (5.4°F) at -50°C and +150°C

80TK Thermocouple Module $59

The Fluke 80TK Thermocouple Module is a low cost temperature measurement accessory designed to work with any digital multimeter. It converts the microvolt output from a "K" type thermocouple into a 1 millivolt per degree signal.

The on-off switch allows selection of degrees "C" or "F" output scaling. Input is via a "mini" thermocouple connector, with provision inside for hardwiring. A bead thermocouple, with miniconnector attached, is included with the 80TK. Immersion probes and surface probes are also available, as are additional bead probes.

The output of the 80TK may be read on any DMM having 10 Mohm or greater input impedance and a 3½-digit display. It is powered by a standard 9V battery, with a typical operating life of 1600 hours. Battery condition can be checked on the DMM with battery test instructions printed on the 80TK.

Measurement Range: -50°C to 1000°C (-58°F to 1832°F)
Ambient Operating Range: 0°C to 50°C; 32°F to 122°F
Accuracy:
-20°C to 350°C 0.5% ±2°C
-4°F to 662°F 0.5% ±3.6°F
351°C to 500°C 1.75% ±2°C
665°F to 932°F 1.75% ±3.6°F
501°C to 1000°C 2.0% ±2°C
933°F to 1832°F 2.0% ±3.6°F
-50°C to -21°C 2.5% ±2°C
-58°F to -5.8°F 2.5% ±3.6°F

80TK Accessories

80PK-1 (included) $12
Bead probe with Teflon tape insulation for general purpose applications. Not suitable for liquid immersion. Measurement range: 0°C to 260°C (32°F to 500°F). Useable to -40°C (-40°F)

80PK-2 $38
Immersion probe for liquids and gels. Protected from tip to handle by an Inconel sheath. Can also be used in most other temperature measurement applications. Measurement range: 0°C to 927°C (32°F to 1700°F).

80PK-3 $79
Surface probe for flat or slightly convex surfaces. Exposed tip allows direct contact with surface being measured. Measurement range: 0°C to 260°C (32°F to 500°F).

80T-SP Type K Surface Thermocouple $95

For use with 8024A and 8024B for measuring the temperature of flat or slightly convex surfaces.

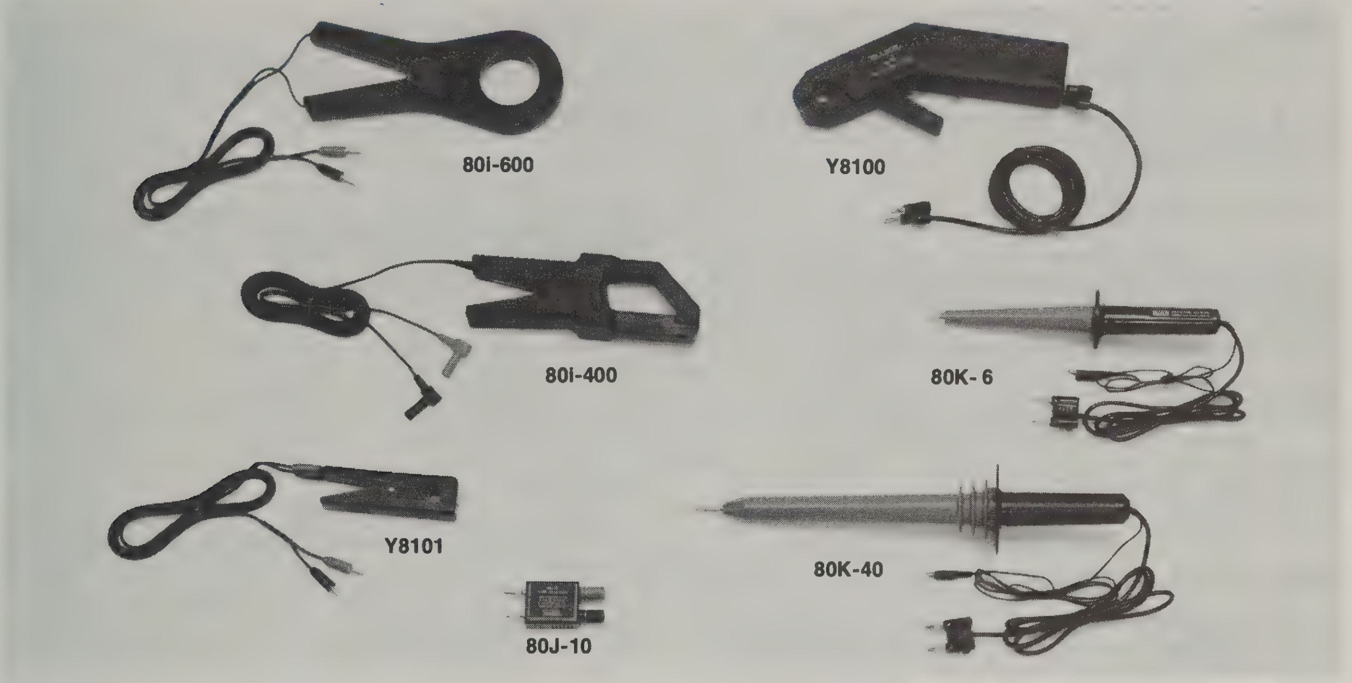
Time Constant: 4 seconds typical on metal surface; 15 seconds max. for a 260°C change
Range: 0°C to 260°C, handle and cable 105°C maximum
Accuracy: ±2.2°C from 0°C to 260°C (with respect to NBS thermocouple tables). Also depends on good contact between the tip and the surface to be measured.
Probe Diameter: 12.5 mm (.5 in)
Probe Length: 9.4 cm (3.75 in)
Conductor Length: 1.12m (48 in)

Y8102 Type K Thermocouple Probe $60

Designed for use with Fluke 8024A and 8024B Digital Voltmeter. Sheath material is Inconel, especially good for liquid immersion measurements.

Time Constant: 10 seconds, for air at room temperature and one atmosphere of pressure moving 65 feet per second
Temperature Range: 0°C to 926°C (32°F to 1700°F)
Accuracy: ±2.2°C from 0°C to 276.7°C and ±0.75% of reading from 276.7°C to 926°C
Probe Diameter: 3.18 mm (0.125 inch)
Probe Length: 15.2 cm (6 inches)
Conductor Length: 1.12 meters (48 inches)

These probes protect you and your DMM from high voltage and high current without interrupting the circuit under test.



Y8103 Type K Bead Thermocouple $25

For use with 8024A and 8024B in any application except liquid immersion or penetration. Exposed tip provides fast response. Teflon insulation. Four feet.

Time Constant: 2 seconds, for air at room temperature and one atmosphere of pressure moving 65 feet per second
Temperature Range: 0°C to +260°C (32°F to +500°F)
Accuracy: ±2.2°C from 0°C to +260°C
Useable Range: To -40°C (-40°F)

Y8104 Thermocouple Termination $10

Provides isothermal termination for any Type K thermocouple wire connected to 8024A and 8024B. Maximum wire size is #14 AWG. Ensures no temperature difference between the junctions created by the instrument terminals in contact with the thermocouple terminals.

80K-6 High Voltage Probe $45

The 80K-6 extends the voltage measuring capability of an ac/dc voltmeter up to 6000 volts. A 1000:1 voltage divider provides a high input impedance. High accuracy is provided when the divider is used with a voltmeter having a 10 MΩ input impedance. A molded plastic body houses the divider and protects user from voltage being measured.

Voltage Range: 0 to 6 kV, dc or peak ac
Input Impedance: 75 MΩ, nominal
Division Ratio: 1000:1
Accuracy
DC to 500 Hz: ±1%
500 Hz to 1 kHz: ±2%
Above 1 kHz: Output reading falls; typically, -30% at 10 kHz
DVM Compatibility: The 80K-6 achieves rated accuracy when used with an ac/dc voltmeter having 0.25% accuracy, or better, and an input impedance of 10 MΩ ±10%.
Caution: These probes are not intended for electric utility applications in which high voltage is also accompanied by high energy. Rather, they are intended for use in lower energy applications such as television and CRT troubleshooting.

80K-40 High Voltage Probe $80

The Model 80K-40 is a high voltage accessory probe designed to extend the voltage measuring capability of an ac/dc voltmeter up to 40,000 volts. In essence the probe is a precision 1000:1 voltage divider formed by two matched metal-film resistors. The unusually high input impedance offered by these resistors minimizes circuit loading and optimizes measurement accuracy. A special plastic body houses the divider and provides the user with isolation and protection from the voltage being measured.

Voltage Range: 1 kV to 40 kV dc or peak ac, 28 kV rms ac
Input Resistance: 1000 MΩ
Division Ratio: 1000:1
DC Accuracy: ±2% from 20 kV to 30 kV (calibrated 1% at 25 kV); changes linearly from 2% at 30 kV to 4% at 40 kV and from 2% at 20 kV to 4% at 1 kV
AC Accuracy: ±5% at 60 Hz
DVM Compatibility: The 80K-40 provides rated accuracy when used with any voltmeter having a 10 MΩ input impedance. When used with voltmeters with other input impedances, a correction factor and/or shunt resistor is used to obtain the correct value.
Caution: These probes are not intended for electrical utility applications in which high voltage is also accompanied by high energy. Rather, they are intended for use in lower energy applications such as television and CRT troubleshooting.

Y8100 Clamp-on DC or AC Current Probe $229

The Model Y8100 is a clamp-on, Hall-effect probe that can be used with a voltmeter, multimeter, or oscilloscope to read dc, ac, or composite (ac/dc) current measurements. The pistol shape allows safe, easy, one-hand operation when making current measurements. Two ranges, 20A and 200A, produce a 2V output at full range current.

Available through Distributors (See page 248)

The probe battery-low indicator light lets the operator know when the battery voltage is too low for proper operation.

Ranges: 20A ac or dc and 200A ac or dc
Accuracy:
DC to 200 Hz: ±2% of range
200 Hz to 1 kHz: ≤100A add ±3% of reading;
≥100A add ±6% of reading
Working Voltage: Core to output: 600V dc or 480V ac maximum. Output to ground: 42V dc or 30V ac maximum
Maximum Conductor Size: 1.9 cm (.75 in)

Y8101 Clamp-on AC Current Probe $59

The Y8101 is a small clamp-on current transformer designed to extend the current measuring capability of a DMM or ac current meter up to 150 amperes. The coil on the clamp-on core serves as the secondary of a 1000:1 ratio transformer. The current-carrying conductor being measured serves as the primary.

Specified Current Range: 1A to 150A
Accuracy: 48 Hz to 440 Hz ±(2.5% of reading +0.15A);
440 Hz to 1200 Hz ±(3% of reading +0.15A)
Division Ratio: 1000:1
Working Voltage: 300V ac rms maximum
Maximum Conductor Size: 1.11 cm (0.43 in)
Usable Current Range: 0.1A to 200A, 5 seconds maximum above 150A

80i-400 Clamp-on AC Current Probe $69

The Model 80i-400 is a clamp-on current probe designed to extend the current capability of an ac current meter to 400 amperes. A clamp-on, 1000-turn coil designed into the probe allows measurements to be made without breaking the circuit under test. The current carrying conductor being measured serves as the primary. The unique shape of the 80i-400 jaw will accommodate a single 750 MCM THHN (30mm diameter) conductor or two 500 MCM THHN (25mm diameter each) conductors run in parallel.

Specified Current Range: 1A to 400A
Accuracy: ±(3% of reading +0.4A) 48 Hz to 440 Hz
±(4% of reading + 0.4A) 440 Hz to 1000 Hz
Division Ratio: 1000:1
Working Voltage: 660V ac rms maximum
Maximum Conductor Size: 1 each 30mm (1.18 in) or 2 each 25mm (0.98 in)
Usable Current Range: 0.1A to 600A, 5 seconds maximum above 400A

80i-600 Clamp-on AC Current Probe $109

The Model 80i-600 is a clamp-on current transformer designed to extend the current measuring capability of a DMM or current meter to 600 amperes. A coil on the clamp-on transformer core allows measurements to be made without breaking the circuit under test. This coil serves as the secondary of a 1000:1 transformer. The current-carrying conductor being measured serves as the primary. Because of a high efficiency, evenly distributed winding, wire size and location of the wire within the transformer jaws will not affect the accuracy of current measurements.

Specified Current Range: 1A to 600A
Accuracy: ±(2% of reading) 50 Hz to 1000Hz
±(3% of reading) typical 30 Hz to 50 Hz or 1 kHz to 10 kHz
Division Ratio: 1000:1
Working Voltage: 750V ac rms maximum
Maximum Conductor Size: 5 cm (2 in)
Usable Current Range: 0.1A to 2000A, 5 seconds maximum above 600A

80J-10 Current Shunt $30

An inexpensive, simple-to-use accessory that lets you measure ac or dc current using any sensitive voltmeter having banana jack inputs with a standard ¾" spacing. Two 5-way binding posts become the current input terminals. The precision, 0.01Ω shunt resistor will pass 10 amperes continuously without overheating, or up to 20 amperes for one minute. Not compatible with Y8132, Y8134 or TL70 test lead sets.

Sensitivity: 10 mV per ampere
Shunt Resistance: 0.01Ω
Accuracy: ±0.25%, from dc to 10 kHz, typically rising to 1 dB at 100 kHz
Series Inductance: 8.3 nH
Overload: >20A, not fused

Rack Adapters

Fluke bench/systems instruments are designed to be easily mounted in a standard 19-inch rack cabinet. Some have rack-mount panels and some need rack adapters. When adapters are required they are listed with the instrument. See page 230.

Y9108 BNC-Banana Adapter $15

BNC-to-banana adapters permit interconnection between equipment having BNC plugs and equipment with double banana jacks. Caution: Do not use BNC Connectors for floating measurements.

M00-100-714 Panel Protectors $10

A front panel protector is a molded plastic, snap-on accessory which fits over the front panel of a DMM, counter, etc. The cover provides protection for the front panel controls, and is useful for storing or transporting the instrument.

SIGNAL GENERATORS

Introduction

Fluke markets two models of Frequency Synthesizers and four models of Synthesized Signal Generators. They are cost effective, state-of-the-art instruments which excel in automated or manual testing of HF, VHF and UHF devices, and weapons systems. The generators frequency range is from 10 Hz to 1050 MHz, with IEEE-488, RS-232-C or ASCII system control.

Signal Generator Selection Guide

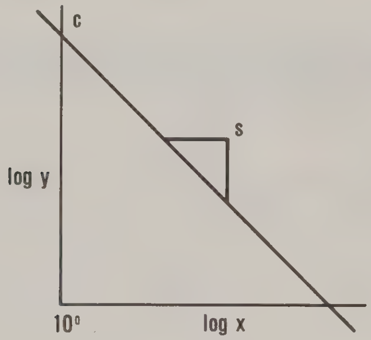
Features	6070A	6071A	6060B	6011A	6160B	6039A/AZ
Frequency						
Upper	520 MHz	1040 MHz	1050 MHz	11 MHz	160 MHz	40 MHz
Lower	200 kHz	200 kHz	10 kHz	10 Hz	1 MHz	1 MHz
Resolution	1 Hz	2 Hz ≥520 MHz	10 Hz	0.1 or 10 Hz	0.1 or 1 Hz	0.1 or 1 Hz
Switching Time	35 ms to 85 ms	35 ms to 85 ms	<100 ms	2 ms to 34 ms	<800 μs	N/A
Output						
Upper	+19 dBm	+19 dBm >520 MHz +13 dBm <520 MHz	+13 dBm	+27 dBm	+ 13 dBm	+13 dBm
Lower	-140 dBm	-140 dBm	-127 dBm	-55 dBm	+3 dBm	+3 dBm
Resolution	0.1 dB	0.1 dB	0.1 dB	0.01 dBm	Continuously Variable	
Spectral Purity (dBc)						
Harmonics	<-30 dBc	<-30 dBc	<-30 dBc (≥100 kHz)	<-50 dBc	<-30 dBc	<-30 dBc
Sub-Harmonic Spurs	—	<-35 dBc	—	—	—	—
Line Spurious	<-56 dBc	<-50 dBc	—	—	—	—
Non-Harmonic Spurs	<-90 dBc	<-84 dBc	<-60 dBc (≥100 kHz)	<-60 dBc	<-83 dBc	<-80 dBc
Phase Noise (20 kHz Offset at 500 MHz)	<-132 dBc/Hz	<-132 dBc/Hz	-113 dBc/Hz (typ.)	-106 dBc/Hz @ 10 MHz	<-121 dBc/Hz @ 160 MHz	<-115 dBc/Hz @ 4 MHz
Modulations Type						
AM	Yes	Yes	Yes	Yes		
FM	Yes	Yes	Yes	Opt.		
ϕM	Yes	Yes	No	No	N/A	N/A
Int. Mod. Freq.	20 Hz to 200 kHz	20 Hz to 200 kHz	400 & 1000 Hz	None		
Simultaneous Mod.	Yes	Yes	Yes	No		
Programming	IEEE-488 Standard	IEEE-488 Standard	IEEE-488 Optional	BCD Standard IEEE-488 or RS-232-C Optional	BCD Standard IEEE-488 Optional	N/A
Reverse Power Protection	Optional 50W	Optional 50W	Standard 50W	No	No	No
RFI	3 μV	3 μV	1 μV	—	—	—
Relative Ampl. & Freq.	Yes	Yes	Yes	Yes	No	No
Volatile Memory	Std. (9 ea.)	Std. (9 ea.)	No	Std. (9 ea.)	No	No
Non-Volatile Memory	Opt. (50 ea.)	Opt. (50 ea.)	Std. (50 ea.)	No	No	No
Digital Sweep	Yes	Yes	No	No	No	No
Audio Output	Yes	Yes	No	No	No	No

Working From Graphed Phase Noise Data

Phase noise data for signal generators is often presented in graphical form, but sometimes one would like to express the same information in an equation, so that it could be manipulated mathematically. Here's how it's done:

The technique is to fit straight-line segments to the phase noise curve, and write equations for the line segments.

Equations of the form $y = cx^s$ plot as straight lines on log-log graph paper. The equation can be written by inspection: the constant, c, is the value of y for which $x = 1$, and the exponent, s, is the slope of the line.



To use this method with a phase noise plot, draw a line tangent to the curve in the area of interest, then extend the vertical axis so that the value at 1 Hz can be read. Record this value (in dBc/Hz), and the slope of the line (in dB/decade). The constant, c, is the 1 Hz intercept value divided by ten, and the exponent is the slope divided by ten. The division by ten follows as a result of the vertical scale having the units, dB, which is 10 log (P_n/P_c), rather than being just the log of P_n/P_c.

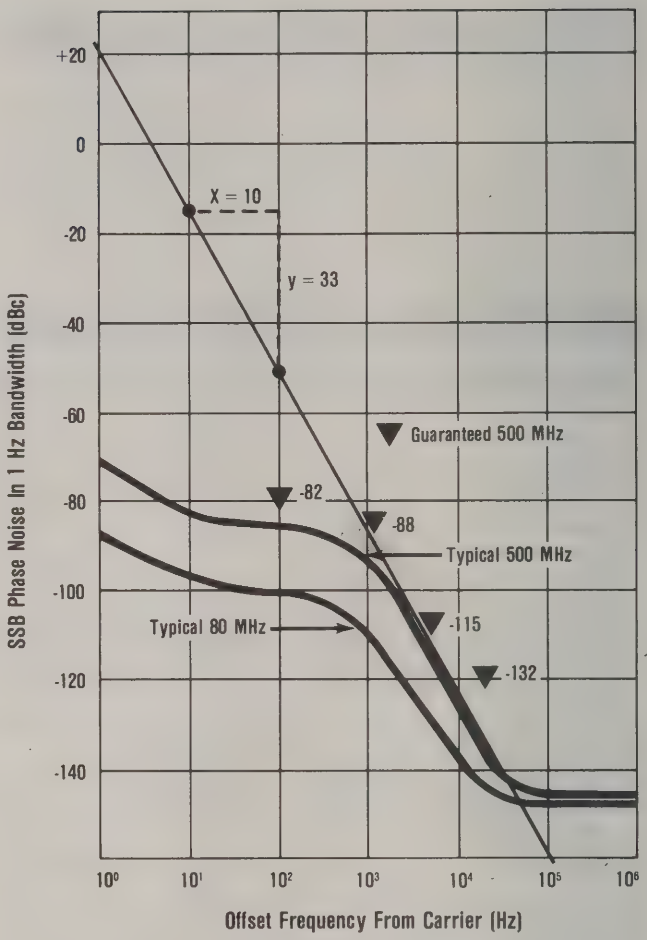
Intercept = + 19 dBc.
Slope = -33 dB./decade

therefore: $c = 10^{+1.9}$ $s = -3.3$

And the equation is: $\mathcal{L}(f_m) = 10^{+1.9} f_m^{-3.3}$

(Valid for f_m between 2 kHz and 30 kHz.)

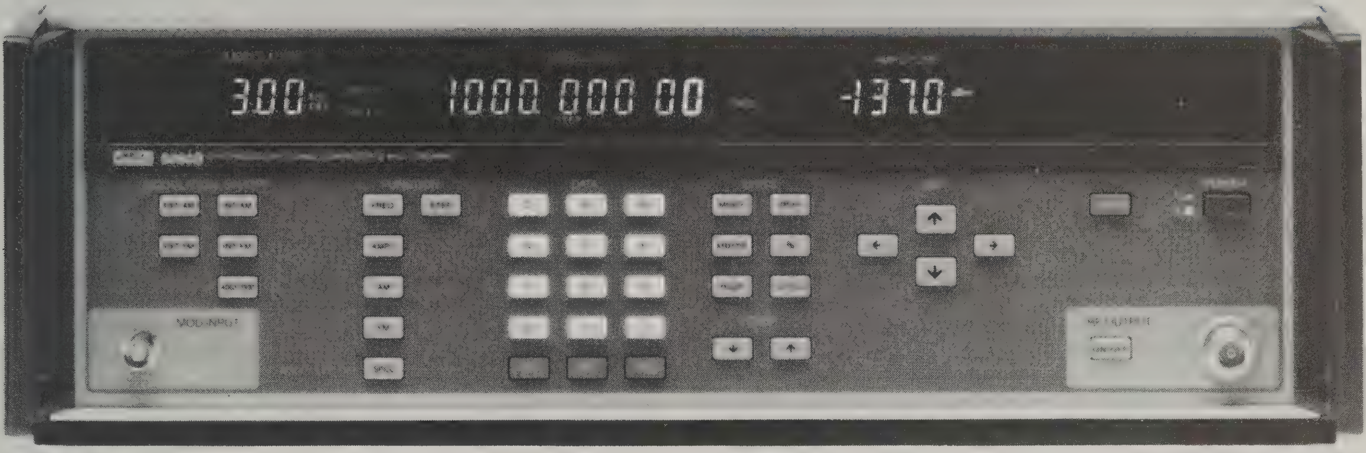
This equation is used to determine residual phase modulation and residual frequency modulation over a specific frequency band offset from the carrier.



SYNTHESIZED SIGNAL GENERATOR

6060B

NEW



6060B

6060B Synthesized Signal Generator

- 10 kHz to 1050 MHz, 10 Hz resolution
- -127 to +13 dBm output, 0.1 dB resolution
- AM and FM, internal and external
- Non-harmonic spurious products less than -60 dBc and harmonics less than -30 dBc down to 100 kHz
- Built-in diagnostics and error code display
- IEEE-488 (optional)
- Reverse power protection
- Non-volatile memory
- Relative frequency and amplitude modes

Low Cost, High Performance

The Fluke 6060B is a fully programmable, synthesized signal generator covering 10 kHz to 1050 MHz. It is designed for applications which require good modulation, frequency, and output level performance with moderate spectral purity for a low price. The 6060B is well suited for testing a wide variety of RF receivers (particularly in-band), and RF devices, such as filters, amplifiers, and mixers.

Performance Summary

The 6060B has the capabilities needed for in-band RF testing. Output frequencies from 10 kHz to 1050 MHz are selectable with 10 Hz resolution. Non-harmonic spurious products are less than -60 dBc and harmonics less than -30 dBc down to 100 kHz, Levels, adjustable from -127 dBm to +13 dBm, can be selected with 0.1 dB resolution.

Amplitude and frequency modulation is standard. Simultaneous internal and external modulation is also standard. A special low-rate, ac-coupled external FM capability can be ordered as a special option.

IEEE-488 Compatible Interface Option

All 6060B functions are accessible via the optional IEEE-488 interface option. The 6060B can process a command string, update the signal output accordingly, and settle in less than 100 ms. A "talk-only" feature is provided as well.

Using the IEEE-488 interface, multiple 6060Bs can be set to track one another in amplitude, frequency, or modulation in a master/slave configuration. As the front panel step-up or step-down key is pressed on the master instrument, the other 6060Bs will follow. This process streamlines frequency tracking applications such as mixer testing, and amplitude tracking applications like two-tone intermodulation tests.

Operational Features

A built-in microprocessor handles all the operational functions, whether from the front panel or the IEEE-488 interface. These functions include:

Keyboard Parameter Entry and **Fluke Bright-digit Editing.**

Increment Step Function, to allow an operator to vary frequency, amplitude, or modulation in specific increments.

Memory Store and Recall, for fifty complete front panel set-ups with internal non-volatile memory.

Relative Amplitude allows compensation for cable losses in test set-ups.

Relative Frequency speeds testing of frequencies relative to a reference, during filter testing or receiver selectivity measurements.

Self-Test Capability

Built-in diagnostics and error code displays provide immediate feedback of incorrect operation. Also, the 6060B performs a series of internal digital and analog tests at power-up and isolates problem areas immediately via a coded display on the front panel. These internal checks may be accessed and initiated at any time from the front panel. Special service and troubleshooting test routines are contained within the unit to aid in calibration and maintenance.

Options Summary

Along with the IEEE-488 option, there are several other options to choose from to help tailor the 6060B to fit unique application requirements. The 6060B has two internal reference options; the high stability reference (Option 130) with ±5 x 10^{-10}/day aging rate; a median stability reference (Option 132) with ±1 x 10^{-7}/day aging rate; rear only RF output option (Option 830).

SYNTHESIZED SIGNAL GENERATOR

6060B

Specifications

Frequency
Frequency Range: 10 kHz to 1050 MHz. Output frequency is displayed on an 8½-digit display
Frequency Resolution: 10 Hz
Switching Speed: >100 ms typical (within ±100 Hz of selected value)
Frequency Accuracy: Referenced to internal free-air 10 MHz crystal oscillator, <±0.5 ppm/month; <±5 ppm for 25°C ±25°C (see also Options 130 and 132). Internal 10 MHz reference sinewave output signal available at rear panel

Amplitude
Amplitude Range: -127 to +13 dBm (+13 dBm peak on AM), with overrange to -147 and +19 dBm, displayed on a 3½-digit display. Fixed-range output, selected by special function, allows more than 12 dB of vernier without attenuator switching
Amplitude Resolution: 0.1 dB. Annunciators for dB, dBm, V, mV, and μV provided on the display
Switching Speed: <100 msec typical (within 0.1 dB of selected value)
Amplitude Accuracy: ±1.0 dB 0.4-1050 MHz (20°C ±5°C)
Output Impedance: 50 ohms, nominal
Output SWR: <2.0; <1.5 below 1 dBm ⩾400 kHz

Spectral Purity
Spurious: <-60 dBc for offsets greater than 10 kHz, (-55 dBc <100 kHz)
Harmonics: <-30 dBc (-26 dBc <100 kHz)
Residual FM (0.3 to 3 kHz band): <13 Hz rms from 245 to 512 MHz (typ. <10 Hz); <27 Hz rms elsewhere (typ. <20 Hz)
Residual FM (0.05 to 15 kHz band): <30 Hz rms from 245 to 512 MHz (typ. <22 Hz); <60 Hz rms elsewhere (typ <44 Hz)
Residual AM: 0.1% rms (-60 dBc) in 0.05 to 15 kHz band (55 dBc <100 kHz)

Amplitude Modulation
Depth Range: 0 to 99%, with 1% resolution (displayed on 2-digit front panel display)
Accuracy: ±(2% + 4% of setting), for 0.1 to 3 kHz rates, depths to 90%, and peak amplitude of <+13 dBm
Distortion: <1.5% THD, to 30% AM; <3% THD, to 70% AM; <5% THD, to 90% AM for <950 MHz and levels <+8.0 dBm
Bandwidth: 20 Hz to 30 kHz, 3 dB
Incidental FM: <0.3 f_m for internal rates and <30% AM

Frequency Modulation
Deviation Ranges: 100 to 999 Hz; 1 to 9.99 kHz; and 10 to 99.9 kHz (displayed on 2-digit front panel display)
Maximum Deviation: Lesser of 99.9 kHz and $2f_mf_o$ above 245 MHz, or $2f_m(f_o+800)$ below 245 MHz, where f_o is in MHz and f_m in kHz (f_o-100)/3 kHz below 0.4 MHz [f_o in kHz]
Accuracy: ±7% for rates of 0.3 to 20 kHz (0.3 to 1 kHz for f_o <0.4 MHz)
Distortion: <1% THD for rates of 0.3 to 20 kHz (0.3 to 1 kHz for f_o<0.4 MHz) and >100 Hz deviation
Bandwidth: 0.02 to 100 kHz, 3 dB unspecified for f_o <0.4 MHz
Incidental AM: <1% AM at 1 kHz rate and deviation of 50 kHz

Modulation Source
Internal: 400 Hz and 1 kHz, ±3% for 20°C to 30°C (add ±0.1%/°C outside this range). Selectable from the front panel
External: 1 volt peak input (MOD IN BNC) provides indicated modulation index. Input impedance = 600 ohms, nominal
Modes: INTAM; INTFM; EXTAM; EXTFM; INTAM and FM: EXTAM and FM; and INT(AM and/or FM) and EXT(AM and/or FM), in all nine combinations. Input impedance = 560 ohms, nominal, when EXTAM and FM are both enabled

Sub-Harmonic External Reference
Input: 1, 2, 2.5, 5, and 10 MHz, 0.3 to 4V p-p sine or squarewave into 50 ohms (nominal)
Input Connector: BNC on rear panel

Non-Volatile Memory
Description: Up to 50 front panel control settings can be retained for 2 years. Battery power is used when the 6060B is in standby or the power cord is not attached

Reverse Power Protection
Protection Level: Up to 50 watts from a 50 ohm source or 50V dc, from 10 kHz to 1050 MHz (dc blocking capacitor at output)
Trip/Reset: Flashing RFOFF annunciator indicates a tripped condition. Pushing RFON/OFF button on front panel will reset the output. Protection is not provided when the instrument is in off

Option Specifications

All options are factory installable, only.

High Stability Reference Option (-130)
Aging Rate: <±5 x 10^{-10}/day, after 21 days
Temperature Stability: <±2 x 10^{-10}/°C. Oven remains powered during standby
Installation: Mounts inside rear panel; includes auxiliary power supply

Mid Stability Reference Option (-132)
Aging Rate: ±1 x 10^{-7}/mo, after 21 days
Temperature Stability: ±1 x 10^{-7} (0° to 50°C)

IEEE-488 Compatible Interface Option (-488)
Functions: All front panel controls except the power switch are programmable via the IEEE-488 interface. Instrument status is also available remotely. Store/recall memory may be accessed via an external controller. The memory data can be reloaded into the 6060B without modification. In the "talk-only" mode, the appropriate commands are output to control another 6060B, 6070A, or 6071A when the front panel step-up or step-down keys are pressed or activated. The 6070A and 6071A only have Frequency Step control.

The 6060B supports the following IEEE-488 functions SH1, AH1, T5, L3, SR1, RL1, PP0, DC1, DT1, C0, E2

Rear RF Output and MOD Input Option (-830)
Description: Moves front panel RF OUTPUT and MOD INPUT connectors to the rear panel

Low-Rate AC-Coupled External FM Option (-651)
Maximum Deviation: 10 kHz or 1000 (f_o-.1)/30 whichever is less
Droop: 15% typical on a 7 Hz squarewave
Bandwidth: 0.5 Hz to 100 kHz, 3 dB, typically

SYNTHESIZED SIGNAL GENERATOR

6060B

General Specifications

Temperature: 0 to 50°C, operating; -40 to 75°C, non-operating
Humidity: 1 to 95% RH to 30°C; 0 to 75% RH to 50°C, operating
Altitude: 3,050m (10,000 feet), operating
Shock and Vibration: Per MIL-T-28800C, except spectral purity may be degraded; 5 to 15 Hz at 0.06 in; 15 to 25 Hz at 0.04 in; and 25 to 55 Hz at 0.02 in
EMI: Radiated emissions induce <1 μV at output frequency into a 1 inch diameter, 2 turn loop, 1 inch from any surface as measured into a 50 ohm receiver. Also compliance with the following standards:
CE03, MIL STD 461B Power and interconnecting leads, 0.015 to 50 MHz;
RE02, MIL STD 461B 14 kHz to 10 GHz, method RE02-1 and RE02-2 of MIL STD 462;
FCC Part 15 (j), Class A;
Power: 100V, 120V, 200V, 240V ac ±10%, 47 to 63 Hz, <180 VA; <15 VA standby with Option 130
Size: 50.8 cm L x 43.1 cm W x 13.3 cm H (20 in L x 17 in W x 5¼ in H)
Weight: <15.9 kg (35 lb)

Model

Model	January 1986 prices
6060B* Signal Generator	$4995

Options

6060B-130 High Stability Reference	850
6060B-132 Mid Stability Reference	300
6060B-488 IEEE-488 Interface	315
6060B-651 Low Rate FM	315
6060B-830 Rear Output and Modulation Input	125

**Available February 1986*

Accessories (Also see page 230)

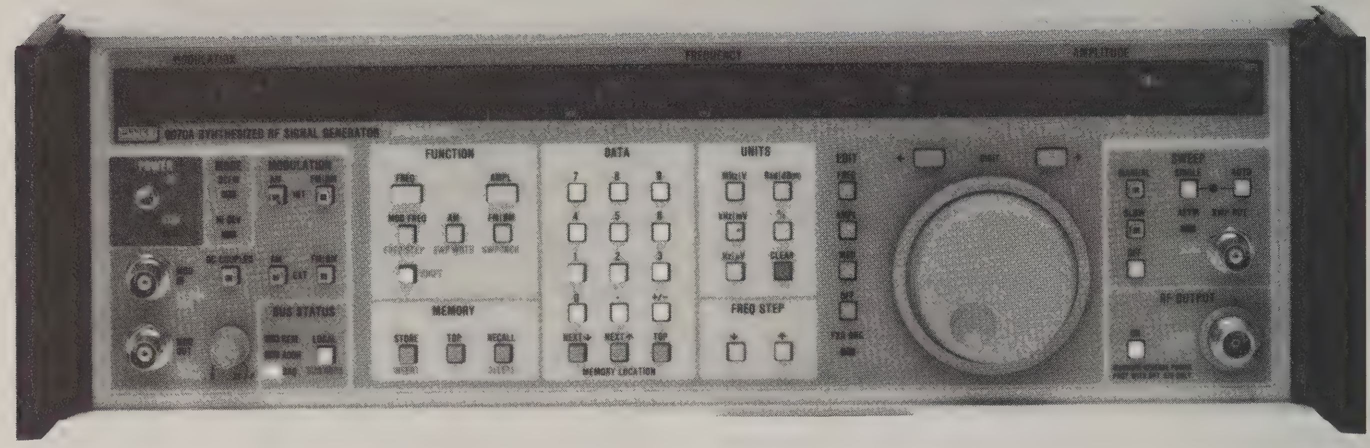
Y6001 Rack Mount Kit, includes 24" slides	275
Y9100 Attenuator, 50 Ohm, 6 dB, BNC	55
Y9101 Attenuator, 50 Ohm, 14 dB, BNC	55
Y9102 Attenuator, 50 Ohm, 20 dB, BNC	55
Y9103 50 Ohm Feedthru Termination, BNC	35
Y9111 3 ft (0.91m) 50Ω Cable, BNC	20
Y9112 6 ft (1.83m) 50Ω Cable, BNC	20
Y9301 Min-Loss Pad, 50Ω to 75Ω	260
Y9307 Adapter, N to BNC, 75Ω	20
Y9308 Adapter, N to BNC, 50Ω	20
Y9315 Coaxial Cable, N male	65
Y9316 Cap, Non-shorting, BNC	10
Y9317 50Ω Termination, N	95

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

SYNTHESIZED SIGNAL GENERATOR

6070A/6071A



6070A

6070A/6071A, to 520 MHz or 1040 MHz

- Non-harmonic spurious outputs: -90 dBc to -100 dBc to 520 MHz
- Precision digital sweep
- Front panel memory
- AM, FM, ϕM modulation
- Responsive spin knob tuning
- Low option VSWR and optional reverse-power protection
- Relative amplitude and frequency mode

Design innovations in the 6070A and 6071A combine the precision resolution and settability of a synthesizer with the low-noise performance of the best open-loop signal generators on the market. And these two state-of-the-art instruments were developed to be competitively priced as well as cost effective in other ways.

The 6070A and 6071A are programmable and directly compatible with IEEE Std 488-1978. With them, you may make sophisticated tests and measurements rapidly and with great precision. On VHF and UHF receivers you can measure selectivity, sensitivity, intermodulation distortion, AM rejection, AGC response, audio hum, noise and distortion, and SINAD ratio. Or you can align a discriminator or check IF response using the digital sweep feature.

Spectral purity is excellent. Spurious outputs, those not related harmonically to either the carrier frequency or the power line frequency, are on the order of -90 dBc to -100 dBc to 520 MHz and -84 dBc above 520 MHz. The typical broadband noise floor is a comfortable -150 dBc per Hz, and the single sideband phase-noise is typically -138 dBc per Hz at 20 kHz offset from a 500 MHz carrier. These specifications, by any standard, reflect a truly excellent level of spectral purity.

AM, FM, ϕM Modulation

Amplitude modulation depth can be set from 0% to 99.9% in 0.1% steps. External dc coupling is provided for leveling, extending bandwidths down to dc, or providing analog control of output amplitude.

Frequency or phase modulation can be set with deviations up to 1 MHz or 100 radians respectively, depending on the rf frequency. Exceptionally wide deviation is made possible by a high deviation mode that is automatically activated when required. External, dc-coupled FM is available for phase locking the instrument to another source. That extends the maximum deviation at low rates, and provides for analog sweeping with an external signal.

Simultaneous AM+FM or AM+ϕM is available internally or from internal-external combinations. The internal modulation oscillator covers a wide range of frequencies. It can be continually varied from 20 Hz to 200 kHz, with an overrange capability extending it from 1 Hz to 255 kHz in steps of approximately 0.1%.

The modulation oscillator output is available at a front panel connector. This provides you with an audio source separate from the rf output. Typical total harmonic distortion is 0.05%.

IEEE-488 Interface

No option is required to make the 6070A or 6071A compatible with IEEE Std 488-1978; the capability is built in. And all of the functions that may be controlled from the front panel manually are also controllable remotely in an IEEE-488 system, except for turning power on and off and controlling the modulation signal output level. Status indicators are: Remote, Addressed, and SRQ. Interface functions are: SH1, AH1, T6, L3, SR1, RL1, DC1, DT1, C0, E2.

Precision Digital Sweep

Versatile sweep modes let you characterize devices such as wideband amplifiers, narrow-band crystal filters, and other rf components. Repetitive, single, or manual modes are available with either symmetrical or asymetrical sweeps. Five sweep step intervals between 20 ms and 500 ms may be selected. A coincidental 0 to 10V staircase sweep signal is available at an output connector to drive X-Y recorders or oscilloscopes. Another rear-panel output signal provides Z-axis blanking for oscilloscopes or a pen-lift signal for X-Y recorders.

Front Panel Program Memory

Up to nine different combinations of front-panel control settings may be stored and later recalled. Up to 50 combinations may be stored in a non-volatile memory using Option -570. This feature reduces errors and saves time in making common measurements.

Responsive Spin-Knob Tuning

In addition to the simple keystroke operation and layout of the front-panel controls, a high-inertia, magnetically detented, optically coupled knob provides analog convenience when continuous

IEEE-488

SYNTHESIZED SIGNAL GENERATOR

6070A/6071A

adjustments are required. It may be used to select frequency, amplitude, or modulation. Each complete turn gives you 25 increments or decrements, depending on direction of rotation.

Low Output VSWR and Optional Reverse-Power Protection

The rf output impedance of the 6070A and 6071A is 50 ohms with a low source VSWR to minimize the effects of signals reflected from loads having a high VSWR. Option -870 protects the output circuits from being damaged when connected to a transceiver that accidentally transmits power.

Relative Units

A relative-amplitude mode makes it easy to compensate for cable loss, attenuation in the rf output, make linearity tests on detectors and amplifiers, and measure AGC characteristics. Output levels are selectable in 0.1 dB steps, all the way from -140 dBm to +19 dBm for frequencies up to 520 MHz (+13 dBm above 520 MHz). Flatness is typically ±0.2 dB from 200 kHz to 520 MHz, ±0.3 dB to 1040 MHz.

Besides offering 1 Hz resolution up to 520 MHz (2 Hz above 520 MHz), a relative-frequency mode allows you to display specific frequencies above and below a selected center frequency. It makes testing the frequency response of filters and IF strips easy.

Specifications

Specifications for frequencies above 520 MHz apply to 6071A only.

Frequency

6070A Ranges: 0.2 to 519.999 999 MHz
6071A Ranges: 0.2 to 1039.999 998 MHz
6070A Resolution: 1 Hz
6071A Resolution: 1 Hz (<520 MHz), 2 Hz (≥520 MHz)
Accuracy & Stability: Same as Reference Oscillator

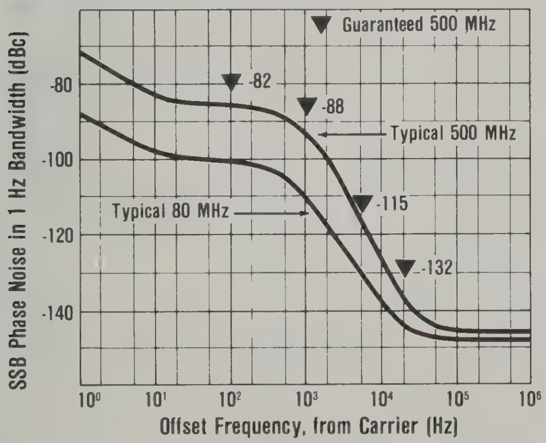
Reference Oscillator

Internal Standard: 10 MHz quartz oscillator. Aging rate ≤±0.5 ppm/month. Temperature effects: <±5 ppm 0 to 50°C instrument ambient (relative to 25°C)
Option -130: 10 MHz ovenized oscillator. (See options)
External: 1, 2, 2.5, 5, 10 MHz input. Level required is 0.3 to 4.0V pp sinewave or squarewave. Input impedance is 50 ohms. External reference is automatically switched in when connected
Reference Output: 10 MHz TTL level

Spectral Purity

All specifications are with High Deviation mode off

6070A & 6071A Phase Noise



SSB Phase Noise for CW and AM Modes (dBc/Hz)

Carrier Frequency Range	Offset Frequency, from Carrier				
	100 Hz	1 kHz	5 kHz	20 kHz	>3 MHz
0.2 to 62.5 MHz	-75	-85	-106	-123	-129
62.5 to 125 MHz	-94	-100	-125	-140	-144
125 to 250 MHz	-88	-94	-121	-138	-144
250 to 520 MHz	-82	-88	-115	-132	-144
520 to 1040 MHz	-76	-82	-109	-126	-138

Residual FM for CW and FM Modes (Hz rms)

Carrier Range	0.3 to 3 kHz bw	0.05* to 15 kHz bw
0.2 to 62.5 MHz	3.5	5.0
62.5 to 125 MHz	0.3	0.75
125 to 250 MHz	0.85	1.3
250 to 520 MHz	1.7	2.5
520 to 1040 MHz	3.4	5.0

**Typically the same for 0.02 to 15 kHz bandwidth.*

Residual AM: ≤0.02% rms (-74 dBc) in a 0.05 to 15 kHz post-detection bandwidth, referred to 100% sinewave modulation. Typically the same in a 0.02 to 15 kHz post-detection bandwidth

Spurious Signals (dBc)

Relationship to Output Carrier Frequency (f_o)	Carrier Frequency Range				
	200 kHz to 62.5 MHz	62.5 MHz to 125 MHz	125 MHz to 250 MHz	250 MHz to 520 MHz	520 MHz to 1040 MHz
Non-Harmonic					
>10 kHz offset	-90	-100	-96	-90	-84
550 Hz to 10 kHz offset	-70	-82	-76	-70	-64
Power Line, Display, Mechanical <550 Hz offset	-56	-68	-62	-56	-50
Sub-Harmonic $f_o/2$, $3f_o/2$, $5f_o/2$ offset	N/A	N/A	N/A	N/A	-35
Harmonic (6070A) f_o, $2f_o$, $3f_o$ offset,					
>+13 dBm	-30	-30	-30	-25	N/A
≤+13 dBm	-35	-35	-35	-35	N/A
Harmonic (6071A) f_o, $2f_o$, $3f_o$ offset,					
>+13 dBm	-30	-30	-25	-20	N/A
≤+13 dBm	-35	-35	-35	-35	-25

Output

Voltage Level Range: -140 dBm to +19 dBm for frequencies up to 520 MHz. Above 520 MHz (6071A), -140 dBm to +13 dBm
Resolution: 0.1 dB or 1% of voltage

Accuracy (dB)

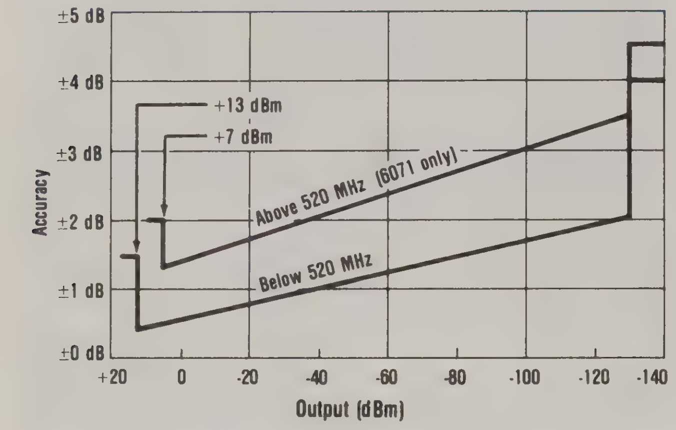
Output	Without Opt -870		With Opt -870	
	0.2 to 520 MHz	520 to 1040 MHz	0.2 to 520 MHz	520 to 1040 MHz
+19 to +13 dBm	±1.5	N/A	±2.0	N/A
+13 to +7 dBm	±(0.8 - 0.01L)*	±2.5	±(1.3 - 0.01L)*	±3.0
+7 to -131 dBm		±(1.6 - 0.015L)*		±(2.2 - 0.015L)*
-131 to -140 dBm	±4	±4.5	±4.5	±5

**L = Level in dBm*

SYNTHESIZED SIGNAL GENERATOR

6070A/6071A

Output Level Accuracy vs Level



Output Impedance: 50 ohms, nominal

SWR

Output Level	0.2 to 520 MHz	520 to 1040 MHz
⩾+7 dBm	2.0	2.5
<+7 dBm	1.5	2.0

Amplitude Modulation

AM Depth: 0 to 99.9% in 0.1% steps

AM Accuracy: (Internal or External)

Carrier Range	Modulation Frequency	AM Depth	Depth Accuracy
0.2 to 5 MHz	⩽1 kHz	<90%	+5%, -8%
5 to 520 MHz	⩽3 kHz	<90%	±5%
520 to 1040 MHz	⩽3 kHz	⩽70%	±5%

AM Distortion

Carrier Range	Modulation Frequency	AM Depth		
		0 to 30%	30 to 70%	70 to 90%
0.2 to 5 MHz	⩽1 kHz	<2%	<5%	<7%
5 to 520 MHz	⩽3 kHz	<1.5%	<3%	<3%
520 to 1040 MHz	⩽3 kHz	<2%	<3%	<5%

AM Signal Bandwidth (-3 dB)

Current Range	AM Depth	Internal or External AC Coupled	External DC Coupled
0.2 to 5 MHz	⩽70%	20 Hz to 8 kHz	DC to 8 kHz
5 to 520 MHz	⩽90%	20 Hz to 50 kHz	DC to 50 kHz
520 to 1040 MHz	⩽70%	20 Hz to 50 kHz	DC to 50 kHz

Incidental FM (for 30% AM): 0.3 x modulation frequency for <520 MHz; 0.6 x modulation frequency for >520 MHz

Frequency Modulation

Maximum Peak Frequency Deviation (kHz)

Frequency Range	ACFM, the lesser of	DCFM, the lesser of
0.2 to 62.5 MHz	999 or fm x (520-fo)	499
62.5 to 125 MHz	199 or fm x fo	fo or 99.9
125 to 250 MHz	499 or fm x fo	fo or 199
250 to 520 MHz	999 or fm x fo	fo or 499
520 to 1040 MHz	999 or fm x fo	fo or 999

fo = Output frequency in megahertz
fm = Modulation frequency in kilohertz

FM Deviation Resolution: 100 Hz for <100 kHz deviation; 1 kHz for ⩾100 kHz deviation
FM Deviation Accuracy: (Internal or external) ±10% at 400 Hz or 1 kHz modulation rate; ±13% at 0.3 to 50 kHz modulation rate (including flatness)

FM Total Harmonic Distortion

Output Frequency Range	DCFM Mode Off and High Deviation:		DCFM Mode
	Off	On	On
	0.5%+		0.5%+
0.2 to 62.5 MHz	0.75% per 100 kHz dev	1.5%	1.2% per 100 kHz dev
62.5 to 125 MHz	3.0% per 100 kHz dev		(600÷fo) % per 100 kHz dev
125 to 250 MHz	1.5% per 100 kHz dev		
250 to 520 MHz	0.75% per 100 kHz dev		
520 to 1040 MHz	0.375% per 100 kHz dev		

fo = Output frequency in megahertz

FM Signal Bandwidth (-3 dB): 20 Hz to 250 kHz internal or ac coupled external. Dc to 250 kHz dc coupled external
Center Frequency Accuracy (DCFM Off): Same as reference oscillator

Center Frequency Accuracy (DCFM On)*

Output Frequency Range	Initial Accuracy	Typical Stability
0.2 to 62.5 MHz	±1 kHz	50 Hz/min
62.5 to 125 MHz	±250 Hz	12.5 Hz/min
125 to 250 MHz	±500 Hz	25 Hz/min
250 to 520 MHz	±1 kHz	50 Hz/min
520 to 1040 MHz	±2 kHz	100 Hz/min

**Auto-CAL upon initialization*

Incidental AM: ⩽0.5% (-52 dBc) for deviations up to 50 kHz at 1 kHz rate (single sideband) component referred to sinewave modulation

Phase Modulation
Deviation and Distortion

Output Frequency Range	Max Peak Deviation Radians	Total Harmonic Distortion per Radian of Deviation with High Deviation Mode	
		Off	On
0.2 to 62.5 MHz	99.9	$0.5 + (0.75 \times 10^{-5} x f_m)$ %	1.5%
62.5 to 125 MHz	19.9	$0.5 + (3.0 \times 10^{-5} x f_m)$ %	
125 to 250 MHz	49.9	$0.5 + (1.5 \times 10^{-5} x f_m)$ %	
250 to 520 MHz	99.9	$0.5 + (0.75 \times 10^{-5} x f_m)$ %	
520 to 1040 MHz	99.9	$0.5 + (0.375 \times 10^{-6} x f_m)$ %	

fm = Modulation frequency in hertz

ϕM Resolution: 0.01 radian for <10 radians, 0.1 radian for ⩾10 radians
ϕM Deviation Accuracy: (Internal or external) ±10% at 400 Hz or 1 kHz modulation rate; ±13% at 0.3 to 3 kHz modulation rate (including flatness)
ϕM Signal Bandwidth (-3 dB): 0.02 to 12 kHz internal or ac coupled external. Dc to 12 kHz external dc coupled
Incidental AM: ⩽0.5% (-52 dBc) for devations up to 50 radians at a 1 kHz rate (single sideband component referred to sinewave modulation)

Modulation Signal Source

Modes: AM, FM, ϕM, AM + FM, AM +ϕM
Range: 0.02 kHz to 200 kHz
Frequency Accuracy: ±3% for 20°C to 30°C ambient temperature range. Add 0.1% per degree C outside that range
Total Harmonic Distortion: <0.15% from 0.2 kHz to 100 kHz; <0.2% below 0.2 kHz and above 100 kHz
Output Level: 0V to 2V peak to peak into 600Ω
Output Impedance: 600Ω, nominal via front panel BNC connector

SYNTHESIZED SIGNAL GENERATOR

6070A/6071A

External Modulation Input

Level: 1V peak for specified AM, FM, or ϕM accuracy
Impedance: 600Ω, nominal
Coupling: AC or DC

Switching Time

Frequency: <85 ms from last controller command (<35 ms for most small changes) until frequency has settled to within 100 Hz of final value. Applies to frequency changes only
Level: <50 ms from last controller command. Applies to level changes only

Frequency Sweep

Sweep Modes: Auto, Single, Manual
Sweep Functions: Symmetrical sweep, asymmetrical sweep, sweep speed
Data Entry: Sweep width, sweep increment
Sweep Speed: Approximately 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, per increment
Sweep Output: 0 to +10V, up to 1000-point stepped ramp. Available at front panel BNC connector
Penlift/Z Axis Blanking: TTL output level at rear panel BNC connector. High during sweep retrace and when sweep is off

Memory

Memory Functions: Store, recall, insert above, delete, top
Locations: 9 standard, volatile; Option-570 50 non-volatile. Front panel set-ups can be stored in each location and later re-called

Remote Programming

Interface: IEEE-488
Functions Controlled: All front-panel controls except line power switch and modulation output amplitude (MOD OUT)
Status Indicators: Remote, Addressed, SRQ.
Interface Functions: SH1, AH1, T6, L3, SR1, RL1, DC1, DT1, C0, E2

Option Specifications

10 MHz Ovenized Oscillator (-130)

Aging rate <±5 x 10^{-10} per day after a 21-day warmup. Temperature effects: <±2 x 10^{-10}/°C

Non-Volatile Memory (-570)

50 locations; operational features same as standard features. Data is stored with built in battery when power is off

Rear RF Output (-830)

Type N rf output connector available on rear panel

Auxiliary RF Output (-831)

Greater than -18 dBm, available at rear panel BNC. Impedance, 50 ohms

Reverse Power Protection (-870)

Up to 50 watts from a 50 ohm source over 0.2 to 1040 MHz. Will withstand up to 50V dc

General Specifications

EMI: Meets MIL-STD 461A RE02 and CE03, and MIL-I-6181D Sections 4.3.1 and 4.3.2 for both narrowband and broadband tests. RF leakage: less than 3 μV is induced into a two-turn, 1 inch diameter loop 1 inch away from any surface and measured into a 50Ω receiver
Temperature: 0°C to 50°C, operating; -40°C to +75°C, non-operating
Relative Humidity: ≤95% to 25°C; ≤75% to 50°C
Altitude: ≤10,000 feet
Power: 100, 120, 200, 240V ac ±10% 47 to 63 Hz; 125 watts typical. For 400 Hz operation consult your Fluke representative
Size: 13.3 cm H x 43.2 cm W x 54.6 cm D from front panel to rear handle (5.25 in H x 17.0 in W x 21.5 in D)
Weight: 27.7 kg (61 lb)
Included: Operator's manual, service manual, power cord

Models

	January 1986 prices
6070A Synthesized Sig Gen (0.2-520 MHz)	$17,625
6071A Synthesized Sig Gen (0.2-1040 MHz)	18,650

Options

607XA-130 Ovenized Reference Oscillator	1155
607XA-570 Non-Volatile Memory	550
607XA-830 Rear RF Output	125
607XA-831 Auxiliary RF Output	175
607XA-870 Reverse Power Protection	250

Accessories (Also see page 230)

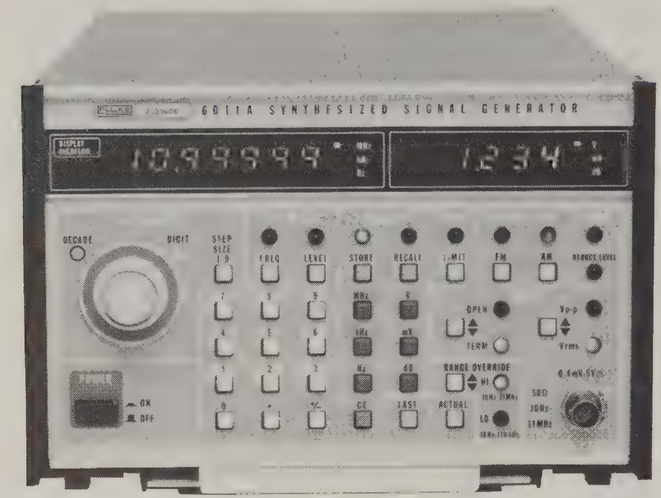
Y6001 Rack Mount Kit, includes 24" slides	275
Y9100 Attenuator, 50 Ohm, 6 dB, BNC	55
Y9101 Attenuator, 50 Ohm, 14 dB, BNC	55
Y9102 Attenuator, 50 Ohm, 20 dB, BNC	55
Y9103 50 Ohm Feedthru Termination, BNC	35
Y9111 3 ft (0.91m) 50Ω Cable, BNC	20
Y9112 6 ft (1.83m) 50Ω Cable, BNC	20
Y9308 Adapter, N to BNC, 50Ω	20
Y9315 Coaxial Cable, N male	65
Y9316 Cap, Non-shorting, BNC	10
Y9317 50Ω Termination, N	95

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

SYNTHESIZED SIGNAL GENERATOR

6011A



6011A

6011A Synthesizers

- 0.1 Hz (7-digit) resolution to 110 kHz; 10 Hz resolution to 11 MHz
- Storage of up to 9 different frequencies
- Residual noise -50 dBc
- Harmonics -35 to -50 dBc
- Level flatness = 0.5 dB
- Frequency switching 2 ms

The 6011A has an output impedance of 50 ohms (75 ohms optional) over the entire frequency range of 10 Hz to 11 MHz, selectable with 0.1 Hz (7-digit) resolution to 110 kHz, 10 Hz resolution to 11 MHz. Frequency is displayed using a 7-digit LED readout. The rms output voltage into a 50 ohm load ranges from 400 μV to 5V or 10V rms into an open circuit or high impedance load. Referred to 1 milliwatt in a 50 ohm load, ranges from -55 dBm to +27 dBm.

The output may be in units of dBm, volts, or millivolts selected with 4-digit resolution using calculator-like front panel pushbuttons and displayed on LEDs. And the output level may be selected in terms of peak-to-peak voltage as well as rms voltage.

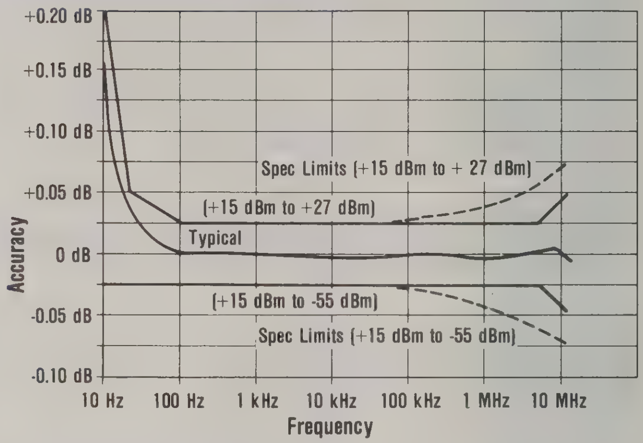
To avoid accidentally selecting an excessive output voltage, a limit may be stored in the 6011A. In addition, you may store up to nine different frequencies and/or output levels that may be recalled at random, quickly and without error — an important consideration for repetitive testing.

Selecting seven-digit frequency resolution is automatic — you don't need to select the high or low range or all seven digits when ending digits are zero. However, you may deliberately override the automatically-selected range when desirable.

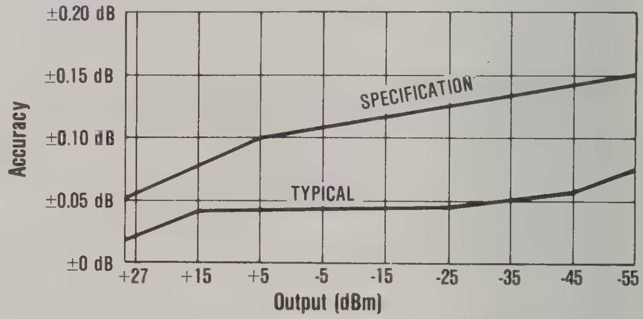
Any selected frequency may be increased or decreased in steps of practically any size, using the EDIT controls. This provides a manual sweep capability for checking frequency response, peaks, nulls, etc. A frequency or output level may be stored as a reference with other frequencies or levels added or subtracted within the instrument's range. This is useful for making relative measurements.

The 6011A can be controlled remotely and operate as part of a system. Option -05 makes the instruments compatible with IEEE Std 488 and Option -06 gives them compatibility with EIA Standard RS-232-C. A seven-line ASCII bit-parallel interface is standard, when you don't order option -05 or -06. All front-panel functions are controllable remotely except for line power and open-terminated-load selection. The IEEE-488 Interface Option has the repertoire AH1, L2, RL1, and E1.

Output Level Accuracy vs Frequency



Output Level Accuracy vs Level



SYNTHESIZED SIGNAL GENERATOR

6011A

Specifications

PARAMETER	
Frequency	
Low Range **High Range**	10 Hz to 109.9999 kHz 10 Hz to 10.99999 MHz
Range Selection	Automatic, with manual override
Resolution	0.1 Hz in the low range 10 Hz in the high range
Display	Seven-digit LED display of frequency set by local or remote control
Annunciation	Units automatically justified in the LED display to indicate maximum resolution
Accuracy	±3 parts in 10^6 for one year over the temperature range of 0°C to +50°C
Aging Rate	<1 part in 10^6 per day or 1 part in 10^6 per year at constant temperature
Temperature	<±2 parts in 10^6 from 0°C to +50°C (<±5 parts in 10^7 from 0°C to +50°C with Option -01)
External Reference	Requires a 10 MHz TTL compatible square wave with symmetry between 40% and 60%. Internal reference is automatically selected in the absence of an external reference
Local Control	Keyboard selection of numerical data, magnitude (Hz, kHz, MHz) and functions. Edit control provided for modifying entry. 6011A programmable in steps of 1-9.
Frequency Storage	Facility to store and recall 9 front-panel control settings including frequency, level, modulation, and output terminal parameters
Remote Control	ASCII standard. IEEE-488 or RS-232-C Optional
Switching and Settling Time	Frequency settles to within 10 Hz of final frequency in low range and 1 kHz in high range in <2 ms in fixed form <34 ms in free form (excluding recall)
Spectral Purity	
Harmonic, Spurious	-30 dBc from 10 Hz to 100 Hz -50 dBc from 100 Hz to 1 MHz -40 dBc from 1 MHz to 11 MHz (Except -35 dBc for output levels within 2 dB of max output from 5 MHz to 11 MHz). Total harmonic distortion from 100 Hz to 110 kHz is <0.15% (typically 0.07%) on low range and 0.3% (typically 0.1%) on high range
Non-Harmonic, Spurious	All non harmonically-related outputs <-60 dBc below output or -110 dBm whichever is greater
Phase Noise	-46 dBc as measured in a 30 kHz bandwidth exluding 1 Hz centered on the carrier, including the effects of the internal standard. Residual (excluding internal standard) is <-50 dBc. Approximately 8 dB improvement on low range
Phase Noise Spectral Density (Typical)	SSB Phase Noise at the output measured in a 1 Hz bandwidth at max output. Approx. 10 dB improvement on low range **Offset from Carrier** — **SSB Phase Noise** 20 Hz — -102 dBc 200 Hz — -108 dBc 20 kHz — -106 dBc 1 MHz — -130 dBc

PARAMETER	
Amplitude	
Impedance	50Ω (75Ω w/Option -10)
Range: **dBm** **Volts**	 +26.98 dBm to -55.01 dBm into 50Ω 5.000V rms to 0.3972 mV rms into 50Ω
Local Control	Keyboard selection of output level in V, mV or dBm, Voltage is selectable in terms of V rms or V p-p and terminated or open circuit. Rotary knob provided for modifying entry and is programmable in steps of 1 through 9
Resolution	0.01 dB
Accuracy	See Graph
Frequency Response	See Graph
Stability vs. Temp	Typical temperature coefficient is 0.003 dB/°C, 20°C to 30°C ±0.2 dB, 0°C to 50°C
Switching and Settling Time	To within: ±1 dB, 150 ms fixed form, ±0.1 dB, 300 ms fixed form, ±0.01 dB, 450 ms fixed form. (Add 200 ms for free form.)
Display	dB; 4-digit LED plus sign in dBm or dB with respect to a stored dBm reference. Volts: 4-digit in V p-p or V rms; open circuit or terminated or volts or dB with respect to a stored voltage reference
AM Modulation	Analog input can be used to provide amplitude modulation. Bandwidth of this input is 10 kHz and max modulation is 90%. Z in = 600Ω 9V p-p corresponds to 90% modulation
Remote Control	ASCII standard. IEEE-488 or RS-232-C Optional
Remote Interfaces	
Standard	Byte serial, bit parallel, seven ASCII-defined parallel lines, plus two handshake lines. Mating Connector Amphenol 57-30240. Also Option -05 and -06
Outputs	
TTL Output	TTL-compatible square wave output (<0.5V to >2.4V p-p into 50Ω) at the synthesized output frequency
Reference Outputs	Derived from the synthesizer frequency reference. 1 MHz output is standard; 5 or 10 MHz available by changing internal jumper. Output is TTL-compatible square wave
Rear Panel Output	Option -04
20 to 31 MHz Tracking	Option -09
75Ω	Option -10

SYNTHESIZED SIGNAL GENERATOR

6011A

Option Specifications

High Performance TCXO Option (-01)

Frequency Accuracy: ±1.5 parts in 10^6 for one year over the temperature range of 0°C to +50°C
Aging Rate: <1 part in 10^8 per 24 hours at constant temperature, or 1 part in 10^6 per year
Temperature Dependence: <±5 parts in 10^7 from 0°C to +50°C

Phase-Lockable Input Option (-02)

Input Frequency: 1,2,2.5,5 or 10 MHz
Input Level: >100 mV, <5V rms into 50Ω. May be used with either the standard oscillator or Option -01. Locking range is ±5 parts in 10^6 from frequency of internal oscillator

Frequency Modulation Option (-03)

General	High Range	Low Range
Deviation	±20 kHz	±200 Hz
Input	1V for 4 kHz ±5V max	1V for 40 Hz ±5V max
Accuracy, 0 to 50°C	±1.5 kHz	±15 Hz
Rate	dc to 10 kHz	dc to 10 kHz
Linearity at Constant Temp	±1 kHz	±10 Hz
Stability at Constant Temp	±400 Hz	±4 Hz
Incidental AM, Typical	<1%	<0.5%
Impedance, Input	600Ω	600Ω

IEEE-488 Interface Option (-05)

Compatible with IEEE Std 488-1978 for use in instrumentation systems. Interface functions are AH1, L2, RL1, and E1.

RS-232-C Interface Option (-06)

Bit serial interface compatible with EIA Standard RS-232-C. Asynchronous data rates from 110 to 9600 baud. Either voltage-level interface or 20 mA current loop. 32-character FIFO buffer.

General Specifications

Altitude: To 3048 meters (10,000 feet) operating
Temperature: 0°C to 50°C, operating; -40°C to 75°C, non-operating
Relative Humidity: ≤80% to 50°C
Power: 115V or 230V ac ±10%, 50 to 60 Hz, 100W, standard. Also 50 to 400 Hz optional and 100V ac optional
Size: 13.3 cm H x 21.6 cm W x 48.2 cm D (5.25 in x 8.5 in x 19 in)
Weight: 11.4 kg (25 lb)
Included: Manual and power cord

Model

January 1986 prices

6011A Synthesized Signal Generator	$5950

Options

6011A-01 High Performance TCXO	360
6011A-02[1] Phase Lock Input	360
6011A-03*[1] Frequency Modulation	955
6011A-04* Rear Panel Output	35
6011A-05*[2] IEEE-488 Interface	365
6011A-06[2]* EIA Standard RS-232-C Interface	665
6011A-07 50-400 Hz Line Power	395
6011A-08 100V, 50-60 Hz Line Power	275
6011A-09* 20-31 MHz Tracking Output	55
6011A-10 75Ω Output Impedance	140

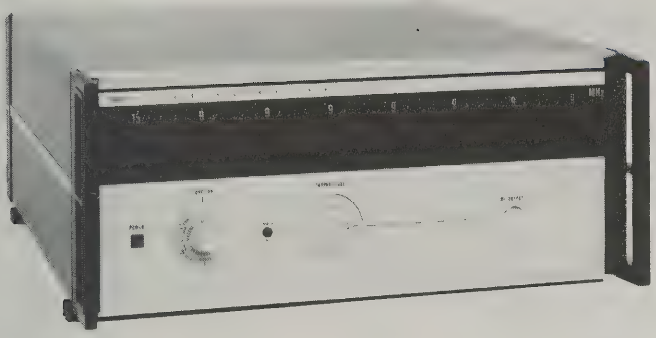
** Field installable options — order -03K, -05K, or -09K*
[1] Cannot have -02 and -03 options together
[2] Cannot have -05 and -06 options together

Accessories (Also see page 230)

Y9111 3 ft (0.93m) 50Ω BNC Cable	20
Y9112 6 ft (1.85m) 50Ω BNC Cable	20
M05-203-601 5¼" Rack Adapter, Offset	110
M05-203-602 5¼" Rack Adapter, Centered	110
M05-200-603 5¼" Rack Adapter, Dual	110
M00-203-631 5¼" Rack Adapter w/18" slides	160

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



6160B

6160B & 6039A/AZ Frequency Synthesizers

- High spectral purity: residual phase noise typically less than -74 dB
- Resolution: 0.1 Hz below 4 MHz; 1 Hz above (6039A/AZ) 0.1 Hz below 12 MHz; 1 Hz above (6160B)
- Level flatness: ±1 dB into 50 ohms
- Switching speed: 800 μs
- Built-in BCD programming (6160B only)
- Optional IEEE-488 (6160B only)

6160B Frequency Synthesizer

The Fluke 6160B Frequency Synthesizer is the industry's most popular VHF synthesizer because of its high spectral purity. It produces frequencies from 1 MHz to 160 MHz in two ranges: 1 MHz to 12 MHz and 10 MHz to 160 MHz. Frequency resolution is 0.1 Hz on the 12 MHz range and 1.0 Hz on the 160 MHz range.

A unique feature of the 6160B is that the highest internally-generated frequency is that of the output VCO, i.e., 80 to 160 MHz. This makes servicing easier, and eliminates UHF EMC problems. Since the output VCO in the 6160B operates from 80 to 160 MHz, frequency division is employed for coverage of lower frequencies. This results in improved spurious specifications for frequencies lower than 80 MHz. Phase noise is similarly reduced for lower bands.

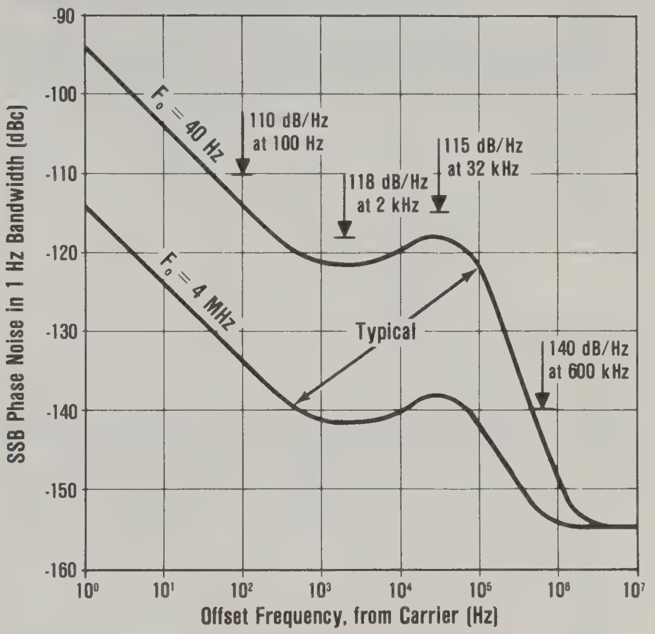
Built-in remote programming is DTL/TTL, BCD, positive true logic or by contact closures. Programming of frequency is via 34 parallel lines, and a remote flag and power flag are provided. Switching is fast, output level is electrically adjustable. Compatibility with IEEE Std 488-1978 is achieved using the Fluke 1120A Translator and 6XXXA-529 Interface.

6039A/AZ Frequency Synthesizer

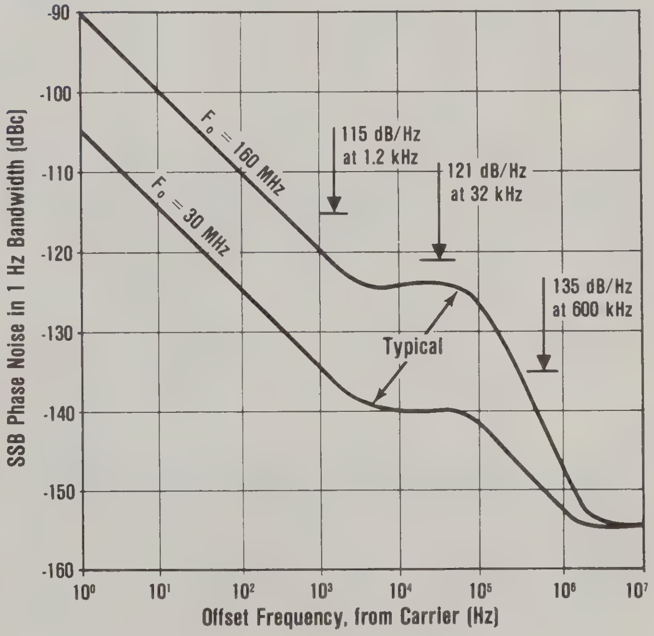
The Model 6039A/AZ is very similar to Model 6160B except it has an upper frequency limit of 40 MHz instead of 160 MHz. The lower range is 1 to 4 MHz and the higher range is 4 to 40 MHz. Frequency resolution is 0.1 Hz on the lower range and 1.0 Hz on the higher range. The main RF output (rear) has a fixed level of +21 dBm into 50 ohms. Auxiliary output of 1 MHz and 100 kHz are also provided.

The highest internally-generated frequency is that of the output VCO, 20 to 40 MHz. This makes servicing easier, eliminates EMC problems at VHF frequencies, and improves phase noise and spurious specifications for frequencies below 20 MHz. The low noise floor of -155 dB/Hz makes this unit ideal for communication systems. The 6039A/AZ does not have remote control capabilities.

6039A/AZ



6160B



FREQUENCY SYNTHESIZERS

6160B & 6039A/AZ

Specifications

PARAMETER	6160B	6039A/AZ
Frequency		
High Band Range **Minimum Step**	10 MHz to 160 MHz 1 Hz	2.5 MHz to 40 MHz 1 Hz
Low Band Range **Minimum Step**	1 MHz to 12 MHz 0.1 Hz	1 MHz to 4 MHz 0.1 Hz
Local Control	Front panel rotary switches	
Remote Control	BCD per decade, TTL, DTL positive true logic or contact closures. Logic "0" = 0 to 0.9V dc. Logic "1" = 2V to +5V dc or open circuit.	Not available for 6039A/AZ
Spectral Purity*		
Non-Harmonic, Spurious	**MHz** **dBc** 1 to 20 -100 20 to 40 -95 40 to 80 -89 80 to 160 -83	**MHz** **dBc** 1 to 4 -100 4 to 5 -98 5 to 10 -92 10 to 20 -86 20 to 40 -80
Harmonic, Spurious	<-25 dBc, typically <-30 dBc	
Amplitude Noise**	<-94 dBc (typical)	<-94 dBc (typical)
Absolute Phase Noise** (Including effects of int'l standard)	<-62 dBc (typical)	<-70 dBc (typical)
Residual Phase Noise** (Not including effects of int'l standard)	<-74 dBc (typical)	<-74 dBc (typical)
Phase Noise Spectral Density **1 Hz Bandwidth**	Offset from Carrier / SSB Phase Noise 1.2 kHz <-115 dBc 32 kHz <-121 dBc 600 kHz <-135 dBc	Offset from Carrier / SSB Phase Noise 100 Hz <-110 dBc 2 kHz <-118 dBc 32 kHz <-115 dBc 600 kHz <-140 dBc
Outputs		
Main Output	Adjustable from +3 dBm to +13 dBm into 50Ω (0.3V to 1V rms) with front-panel control or external dc voltage. Level maintained ±1 dB into 50Ω	
Other Outputs	5 MHz at nominally 1V rms into 50Ω	5 MHz at nominally 1V rms into 50Ω
Output Options	Rear Panel, Opt -04	Rear Panel, Opt -04 +21 dBm Output, Opt -09 10 MHz, Opt -06 1 MHz, Opt -07 100 kHz, Opt -08 Note: Options -06, -07, and -08 are mutually exclusive and replace the standard 5 MHz output
Miscellaneous		
Reference Frequency	External, 5 MHz at 0 dBm to +16 dBm into 50Ω	
Level Control	External, 0.1 to 0.8V dc nominal into >2 kΩ produces an output level change of from +3 dBm to +13 dBm	
Switching Speed	<800 μs to be within 50 Hz of final frequency (applies for frequencies from 80 MHz to 160 MHz. Improves at lower freq.)	Manual Control Only
Internal 5 MHz Frequency Option -02, -05, or Other Source	**Option** **Aging Rate** -02 $\pm 2 \times 10^{-9}$/day -05 $\pm 5 \times 10^{-6}$/yr	**Temp. Stability** 1×10^{-8}, 0°C to 50°C 1×10^{-6}, 0°C to 40°C

* *Noise specifications are for frequencies from 80 MHz to 160 MHz for the 6160B and 20 MHz to 40 MHz for the 6039A/AZ. Noise performance improves for lower frequencies.*

** *Measured in a 30 kHz band excluding the 1 Hz band centered on the signal frequency.*

General Specifications

Altitude: To 3048 meters (10,000 feet), operating; 15240 meters (50,000 feet), non-operating
Temperature: 0°C to 50°C, operating; -62°C to +70°C, non-operating
Relative Humidity: ≤80% to 50°C
Power: 115V or 230V ac ±10%, switch-selectable, 50 to 440 Hz. 80W for 6160B. 55W to 81W for 6039A/AZ, depending on options
6039A/AZ Size: 48.3 cm W x 13.3 cm H x 50.8 cm L (19 in x 5.25 in x 20 in)
6160B Size: 48.3 cm W x 17.8 cm H x 50.8 cm L (19 in x 7 in x 20 in)
6039A/AZ Weight: 19 kg (42 lb)
6160B Weight: 20.5 kg (45 lb)
Included: Manual, power cord, mating connector for programming input lines (6160B only)

Models

January 1986 prices

6160B* Frequency Synthesizer	$8725
6039A/AZ* Frequency Synthesizer	8990

**Option -02, -05 or an external 5 MHz time base is required*

Options

6039/6160B-02* Frequency Std. 2×10^{-9}/day	980
6039/6160B-04 Rear Panel RF Output	55
6039/6160B-05* Frequency Std. 5×10^{-6}/year	380
6XXXA-522K 1120A Interface, field installable	325
6XXXA-529** IEEE-488 Interface	380

* *Factory or Service Center installation only.*

** *Requires 1120A IEEE-488 Translator. Includes 6XXXA-522K and Y7205 Cable.*

Options for 6039A/AZ

6039A-06* 10 MHz Buffered Output	35
6039A-09 +21 dB Output Amplifier	450

* *Instead of standard 5 MHz Auxilliary Output. Factory or Service Center installation only.*

Accessories (Also see page 230)

1120A IEEE-488 Translator	550
Y7205 6 ft Ribbon Cable for 6XXXA-522K	75
Y9111 3 ft (0.93m) 50Ω BNC Cable	20
Y9112 6 ft (1.85m) 50Ω BNC Cable	20
M07-205-600 7" Rack Adapter	105
M00-280-610 24" Rack Slides (Rack Adapter req'd)	110

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

Introduction

The Fluke line of electronic counters provides frequency, period, time interval, events totalizing and frequency ratio measurements in the range of dc to 1.3 GHz. Fluke counters are accurate, reliable, transportable and cost competitive, designed to meet the stringent accuracy and stability demands placed on today's digital measurement equipment. Low power battery operated ovenized units can be aligned in the calibration lab and remain stable while transported to the measurement location. Some models offer IEEE-488 bus operation.

Selection Guide

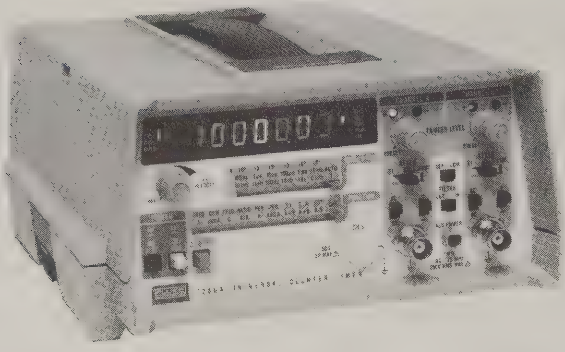
Characteristics	**7250A**	**7260A**	**7261A**	**7220A**	**1900A**	**1910A**	**1911A**	**1912A**	**1953A**
Measurement									
Basic Frequency (MHz)	80	125	125	1300	80	125	250	520	125
Optional Channel (C)	—	1300*	1300*	—	—	—	—	—	1250*†
Frequency Ratio A/B	●	●	●	—	—	**	**	**	●
Period and Time Resolution	100 ns	100 ns	10 ns	—	100 ns	100 ns	100 ns	100 ns	100 ns
Period Average Resolution	1 ps	1 ps	0.1 ps	—	100 ps	100 ps	100 ps	100 ps	1 ps
Time-Interval-Average Res.	—	31.6 ps	31.6 ps	—	—	—	—	—	—
Modulated Timebase Option	—	—	●	—	—	—	—	—	—
Counts Per Minute (x100)	●	●	●	—	—	—	—	—	—
Totalize A	●	*(4)*	*(4)*	—	●	●	●	●	*(4)*
Triggering									
AC or DC Coupling	AC	Both	Both	AC	AC	AC	AC	AC	Both
+ or − Slope	●	●	●	—	—	—	—	—	●
50 MHz Sensitivity (rms)	10 mV	10 mV	10 mV	10 mV	25 mV	15 mV	15 mV	15 mV	30 mV
Noise Filter	●	●	●	●	●	—	—	—	—
10x, 100x Attenuation	*(1)*	Both	Both	*(1)*	10x	10x	10x	10x	10x
Trigger Level Control	*(2)*	●	●	—	—	●	●	●	●
Trigger Level Lights	—	●	●	—	—	—	—	—	●
Trigger Level Output	—	●	●	—	—	—	—	—	●
Marker Output	—	●	●	—	—	—	—	—	●
Time Interval Holdoff	—	●	●	—	—	—	—	—	—
Timebase									
TCXO Option	●	●	●	●	—	●	●	●	Std.
Oven Options	Two	Two	Two	Two	—	—	—	—	Two
External Input	●	●	●	●	—	●	●	●	●
Internal Output	—	●	●	●	—	—	—	—	●
Miscellaneous									
Number of Digits	7	8	8	9	6	7	7	7	9
Autoranging	●	●	●	●	●	●	●	●	—
Battery Option	●	●	●	●	●	●	●	●	—
Data Output Option	●	●	●	●	●	●	●	●	●
IEEE-488 Option	*(3)*	*(3)*	*(3)*	*(3)*	—	—	—	—	●
RFI Shielding (MIL-STD-461)	●	●	●	●	—	—	—	—	—
USA Basic Price	$1040	$1295	$1475	$1365	$425	$595	$695	$865	$1750

**Also 520 MHz option available*
***Using external timebase input*
† Also 1000 MHz option

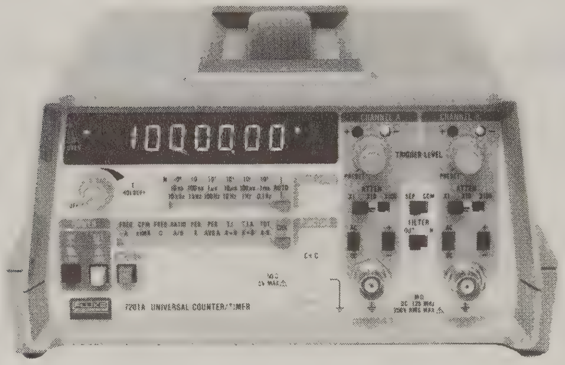
(1) 1x to 10x variable plus 10x switch
(2) Three switch-selectable levels
(3) Via Fluke 1120A IEEE-488 Translator
(4) Gated totalize

UNIVERSAL COUNTER/TIMERS

7260A/7261A



7260A



7261A

7260A & 7261A Universal Counter/Timers

- 8-digit display
- 100 MHz clock/10 nS resolution (Model 7261A)
- Phase modulation timebase option available on Model 7261A
- X1, X10, X100 attenuation
- 100 kHz low-pass filter
- Selectable + or — slope triggering and ac or dc coupling

The 7260A and 7261A are Fluke Counter/Timers packaged in the versatile Portable Test Instrument (PTI) case. Both counters will measure frequencies to 125 MHz, or (optionally) to 520 MHz or 1300 MHz, with a 50Ω channel (Channel C).

The instruments are essentially alike except the 7261A has a 100 MHz clock, with a corresponding basic resolution of 10 ns, and the 7260A has a 10 MHz clock, with 100 ns resolution. Both counters will make time-interval or signal-period measurement and will average from 10^0 to 10^5 such measurements per reading when greater resolution or accuracy is desired. That extends the resolution of the 7261A to 31.6 ps for time-interval measurements or to 0.1 ps for period measurements. In addition, the 7261A is available with a unique phase-modulated timebase option to assure averaging out small consistent errors.

A broadband attenuator lets you select 1X, 10X or 100X attenuation to minimize interference from signal noise and to trigger near the peak of high amplitude signals. And a switchable 100 kHz low-pass filter solves the problem of high frequency contamination of audio frequency signals. The signal may be dc coupled or ac coupled and either + or − slope of the sign may be selected for triggering. The Channel A and Channel B trigger level controls have a zero-volt preset position for easy triggering on sinewaves and other signals that cross the zero-volt level.

Trigger status lights tell when triggering is unstable, and the precise trigger level setting of both channels may be monitored at a rear panel connector. Also at the rear panel is a marker output — a gate signal that brackets each period or time-interval measurement. The marker is for use with an oscilloscope. The trigger level and marker outputs are for making accurate timing measurements such as the rise time and fall time of complex signals. A time interval holdoff control with a 1000:1 ratio (20 μs to 20 ms) delays the end of the marker gate to measure the precise portion of a signal that you want to.

Simple, Hands-Off Operation

But you don't have to use all the controls and features. These counters are designed to let you keep your hands and mind on the job instead of on the counter controls. Select the measurement function you want, set the resolution switch to AUTO range and they will automatically choose the correct range for best resolution, position the decimal point properly, and light an annunciator LED to inform you of the unit of measurement.

Portable Counter, Ovenized Accuracy

For applications demanding the best possible accuracy, ovenized timebase oscillators are available. These oscillators consume such low power they can be used when the counters are operating from batteries. When you go out on a field assignment you can switch to battery power and keep the oscillator warm and standing by for instantaneous use with maximum stability and accuracy. There are two oven options to choose from, one with an accuracy of $\pm 1 \times 10^{-7}$, and one with an accuracy of $\pm 3 \times 10^{-8}$, over the 0°C to 40°C temperature range.

IEEE-488 and PTI

The Fluke-developed portable test instrument (PTI) packaging concept allows you to easily configure low-cost, convenient mini-test systems using the Fluke 1120A IEEE-488 Translator. A number of compatible Fluke instruments can be interfaced via the 1120A, including counters and digital voltmeters. The unique stack-and-latch design makes them easy to carry about. Means less bench space, too.

Low Susceptibility, Minimal RF Radiation

A lightweight, internal, stainless steel shield completely surrounds the instruments and mates with the metal front and rear panels to provide an rf enclosure meeting most requirements of MIL-STD-461. This means low susceptibility in high rf environments as well as minimal radiated energy to interfere with nearby rf-sensitive equipment.

Specifications

Frequency Measurements (Channel A)
Range: 0 Hz to 125 MHz
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ±1 count ± timebase error*
Display: kHz or MHz with decimal
**See Timebase Characteristics chart*

Frequency Measurements, Channel C (Option -310 or -331)
Range: 50 MHz to 520 MHz (Option -310); 100 MHz to 1300 MHz (Option -331)
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ±1 count ± timebase error*
Display: kHz or MHz with decimal
**See Timebase Characteristics chart*

Ratio Measurements (A/B)

Range: 0 Hz to 125 MHz for channel A, 0 Hz to 2 MHz for Channel B
Resolution: ±frequency of B ÷ N* x frequency of A
Accuracy: Resolution ± frequency of B x trigger error of B÷N*
Display: Decimal, no annunciator

Period Measurements (Channel A)

Range: 100 ns to 999,999.99 seconds for 7260A, or 10 ns to 99,999.999 seconds for 7261A
Frequency Range: 0 Hz to 2 MHz, sinewave
Pulse Width: ≥500 ns from 0 Hz to 100 kHz, ≥250 ns from 100 kHz to 2 MHz
Resolution: 10 ms to 100 ns in decade steps for 7260A, or 1 ms to 10 ns in decade steps for 7261A
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms, or sec with decimal for 7260A, μs, ms, or sec with decimal for 7261A

Period-Averaged Measurements (CH A)

Range: 1 ps to 9,999,999.9 μs for 7260A; 0.1 ps to 999,999.99 μs for 7261A
Frequency Range: 0 Hz to 2 MHz, sinewave
Pulse Width: ≥500 ns from 0 Hz to 100 kHz, ≥250 ns from 100 kHz to 2 MHz
Resolution: 100 ns to 1 ps in decade steps for 7260A; 10 ns to 0.1 ps in decade steps for 7261A
Accuracy: 100 ns ÷ N* ± timebase error ± trigger error ÷ N* for 7260A, or 10 ns ÷ N* ± timebase error ± trigger error ÷ N* for 7261A
Display: μs or ms with decimal

**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles averaged in ratio mode.*

Time-Interval Measurements (CH A/CH B)

Range: 100 ns to 999,999.99 sec, for 7260A, or 10 ns to 99,999.999 sec. 7261A
Frequency Range: 0 Hz to 5 MHz, sinewave
Pulse Width: ≥50 ns, for 7260A, ≥10 ns for 7261A
Resolution: 100 ns to 10 ms in decade steps for 7260A, 10 ns to 1 ms in decade steps for 7261A
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms or sec 7260A; μs, ms, sec 7261A
Time Interval Holdoff: 20 μs to 20 ms, continuously variable

Time-Interval-Averaged Measurements (CH A/CH B)

Range: 1 ns to 9,999,999.9 μs for 7260A, or 0.1 ns to 999,999.99 μs for 7261A
Frequency Range: 0 Hz to 5 MHz, sinewave
Pulse Width: ≥50 ns for 7260A, ≥10 ns for 7261A
Resolution: 100 ns ÷$\sqrt{N}$* for 7260A, 10 ns ÷$\sqrt{N}$* for 7261A
Accuracy: 100 ns ÷$\sqrt{N}$* ±10 ns ± timebase error ± trigger error ÷ $\sqrt{N}$* for 7260A; 10 ns ÷$\sqrt{N}$* ± timebase error ± trigger error ÷$\sqrt{N}$* for 7261A
Dead Time: 4 μs
Display: μs ms, with decimal

**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles of B averaged in ratio mode.*

Totalize (CH A Gated by CH B)

Range: 0 Hz to 125 MHz for channel A, 0 Hz to 2 MHz for channel B
Count Capacity: 99,999,999
Display: Total count, no decimal or annunciator
Time Interval Holdoff: Range, 20 μs-20 ms, cont variable

Counts Per Minute (cpm x100 , CH A)

Range: 0 Hz to 125 MHz
Count Time: 600 ms (1/100 minute)
Resolution: 100 cpm, fixed
Accuracy: ±1 count ± timebase error
Display: No decimal or annunciator

Channel A & B Input Characteristics

Bandwidth: 0-125 MHz, dc coupled; 5 Hz-125 MHz, ac coupled
Selection: Separate or A connected to B (Sep/Com)
Sensitivity: 10 mV rms, 0 to 50 MHz; 15 mV rms, 50 to 100 MHz; 35 mV rms, 100-125 MHz
Minimum Pulse: 50 ns at 50 mV pk (7260A); 10 ns at 50 mV pk (7261A)
Impedance: 1 MΩ, 50 pF, nominal
Coupling: ac or dc
Attenuator: X1, X10, X100, switchable
Slope: + or −, switchable
Filter: Low pass, 100 kHz 3 dB point, nominal
Trigger Level Range: +1.5V to -1.5V
Linear Operating Range: +2.5V to -2.5V
Maximum Input: 100V rms 0 Hz to 45 Hz, 250V rms 45 Hz to 50 kHz decreasing to 5V rms at 1 MHz, 5V rms 1 MHz to 125 MHz

Channel C Input Characteristics (Option -310 or -331)

Bandwidth: 50 MHz to 520 MHz (Option -310); 100 MHz to 1300 MHz (Option -331)
Sensitivity: 10 mV rms (Option -310); 5 mV rms to 600 MHz, 10 mV rms from 600 MHz to 1000 MHz, 40 mV rms from 1000 MHz to 1300 MHz (Option -331)
Impedance: 50Ω, 2.5: 1 VSWR, maximum
Maximum Input: 5V rms, fused

External Timebase Input

Frequency: 10 MHz, ac coupled
Sensitivity: 300 mV rms
Impedance: 1 kΩ, 30 pF, nominal
Maximum Input: 3V rms

Triggering

Trigger Level Output: ±1.5V level indicates dc trigger level set on either Channel A or B, switch-selectable
Trigger Status Indicators: Two per channel provide positive indication that the input signal is triggering the input amplifier and relative indication as to where on the signal the input amplifier is being triggered
Cont/Trig Mode: Rear panel switch activates external trigger mode for initiating a measurement

Timebase Characteristics

Characteristics	Option			
	Standard	-112 TCXO	-131 Oven	-132 Oven
Frequency	10 MHz	10 MHz	10 MHz	10 MHz
Aging Rate (Const. Temp)	$\pm5\times10^{-7}$/mo	$\pm3\times10^{-7}$/mo $\pm1\times10^{-6}$/yr	$\pm1\times10^{-7}$/mo*	$\pm5\times10^{-8}$/mo* $\pm3\times10^{-9}$/day*
Temperature Accuracy (0°C to 40°C)	$<5\times10^{-6}$**	$\pm2\times10^{-6}$	$\pm1\times10^{-7}$	$\pm3\times10^{-8}$
Line Variation (±10% change)	$\pm1\times10^{-7}$	$\pm2\times10^{-8}$	$\pm2\times10^{-8}$	$\pm4\times10^{-9}$
Battery Operation	$\pm1\times10^{-7}$	$\pm2\times10^{-8}$	$\pm5\times10^{-8}$	$\pm1\times10^{-8}$
Warm-up 10 Minutes 20 Minutes	 — —	 — —	 $\pm5\times10^{-7}$ $\pm3\times10^{-8}$	 $\pm5\times10^{-7}$ $\pm3\times10^{-8}$

** After 5 days of continuous operation*
*** Peak-to-peak variation over temperature range*
(1) Timebase error is the sum of all errors specified for the particular timebase (see timebase specifications)
(2) Trigger error is the measurement error caused by noise on the input signal triggering the input amplifier too early or too late, calculated as follows:

$$\text{Microseconds of trigger error} = \frac{2 \text{ x pk noise voltage (V)}}{\text{signal slope at trigger point (V/}\mu\text{s)}}$$

or Trigger error = ±0.3% of one period divided by numbered periods averaged for signals with better than 40 dB signal to noise ratio and 100 mV rms amplitude, whichever is greater.

UNIVERSAL COUNTER/TIMERS

7260A/7261A

Option Specifications

Battery Pack Option (-010)
Type: Nickel-Cadmium, size F
Operating Time: 2.8 hours (2 hours, 7261A) typical continuous, decreasing to 2 hours (1.5 hours, 7261A) worst case
Charge Time: 16 hours at room temperature
Charge Protection: Thermistor-actuated shutdown of charging circuit if battery temperature exceeds 65°C
Discharge Protection: Automatic low-voltage shutdown to prevent over discharge
Note: Not compatible with Option -331

PTI Interface (-521)
Type: Serial BCD output of all digits and measurement units
Levels: TTL, "1" state low

Personality Card Option (-522K)
For 1120A IEEE-488 Translator. Part of Option -529

IEEE-488 Interface Option (-529)
Description: Interfaces the 7260A or 7261A to IEEE-488 via the Fluke 1120A IEEE-488 Translator. (Note: 1120A must be purchased separately.) Provides full measurement output capability as well as remote selection of all functions and ranges.
Repertoire: SH1, AH1, T5, L4, SR1, RL2, DC1, DT1

Timebase Phase Modulation Option (-190) 7261A only
Description: Option insures valid time interval averaging of clock-synchronous signals by phase modulating internal timebase

520 MHz Channel C Option (-310)
Description: Provides third channel input to measure frequencies from 50 MHz to 520 MHz
Sensitivity: 10 mV rms
Input Impedance: 50Ω
VSWR: 2.5:1, maximum
Maximum Input: 5V rms, fuse-protected

1300 MHz Channel C Option (-331)
Description: Provides third channel input to measure frequencies from 100 MHz to 1300 MHz and has a triggered mode to capture and display bursts as short as 3.6 ms
Sensitivity: 5 mV rms to 600 MHz, 10 mV rms from 600 MHz to 1000 MHz, 40 mV rms from 1000 MHz to 1300 MHz
Input Impedance: 50Ω
VSWR: 2.5:1 maximum
Maximum Input: 5V rms, fuse-protected

General Specifications

Display: 8-digit LED with leading zero suppression, decimal, and annunciators
Cycle Rate: Fixed 250 ms between readings
Reset: Reset button clears display, lights all display segments and, on release, activates a new measurement
Self Check: Counts and displays 10 MHz clock
Marker Output: TTL compatible output. Positive going edge indicates Channel A trigger, negative going edge indicates Channel B trigger. Typical delay from the time signal triggers input amplifier to the time marker changes level at rear panel output is 30 ns for the 7261A, 75 ns for the 7260A
Temperature: 0°C to 40°C, operating; -40°C to +70°C, non-operating
EMI: Internal metal RFI shield (tested to MIL-STD-461, Notice 3).
Safety: Designed to meet requirements of UL 1244 and IEC 348
Power: 100V, 120V, 220V or 240V ±10%, 47 to 63 Hz, 32 VA max
Size: 32.7 cm L x 20.3 cm W x 10.8 cm H (12.9 in L x 8.0 in W x 4.3 in H)
Weight: 3 kg (6.5 lb)
Included: Instruction manual, power cord. Order Y9111 or Y9112 coaxial cable(s) separately

Models

January 1986 prices

7260A Universal Counter/Timer	$1295
7261A Universal Counter/Timer	1475

Options

72XXA-010*	Rechargeable Battery Pack	435
72XXA-112*	TCXO, 2 ppm	245
72XXA-131*	Low Power Oven	295
72XXA-132*	Superior Low Power Oven	545
7261A-190**	Timebase Phase Modulation (7261A only)	190
72XXA-310*	50-520 MHz, Channel C	380
72XXA-331***	100-1300 MHz, Channel C	680
72XXA-521**	PTI Interface w/PTI Cable	190
72XXA-522K	Personality Card, for 1120A	215
72XXA-529[1]	IEEE-488 Interface	375

* *Factory or Service Center installation only.*
** *Factory option only.*
*** *Not compatible with Option -010. Also factory option only.*
[1] *Includes parts needed to interface the 7260A or 7261A to IEEE-488. Parts can only be used in conjunction with Fluke 1120A IEEE-488 Translator. Includes 72XXA-521, 72XXA-522K, and Y7203 2 ft ribbon cable. The -529 Option can be ordered and installed at time of manufacture only. For existing instruments which do not have the -529 Option installed, an IEEE interface can be added by ordering -521 and -522K Options (1120A also required). The -521 Option must be installed at a Factory Service Center.*

Accessories (Also see page 230)

1120A IEEE-488 Translator	550
A53 Whip Antenna	30
Y7201 Attenuator/Filter	65
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω	20
Y9112 6 ft (1.85m) Coaxial Cable, 50Ω	20
Y9103 50Ω Feed-thru Termination	35
Y2014 5¼" Rack Adapter, Single	90
Y2015 5¼" Rack Adapter, Double	90
Y2020 Panel Mounting Kit	90
Y7203 2 ft PTI Ribbon Cable	50
Y7204 5 ft PTI Ribbon Cable	65
Y2023 PTI Accessory Case	125

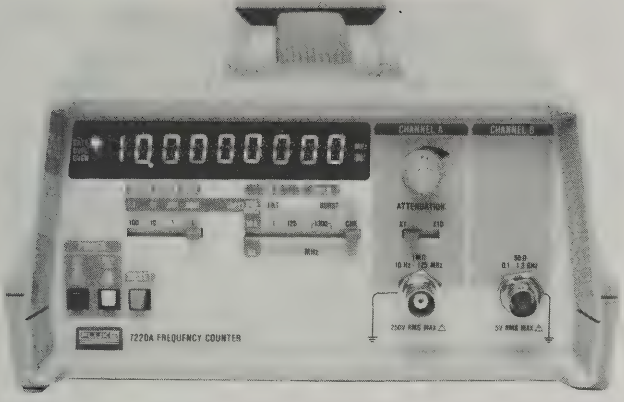
After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

IEEE-488

COMMUNICATIONS COUNTER

7220A



7220A

7220A Communications Counter

- 9-digit display
- Channel A range: 10 Hz to 125 MHz
- Channel B range: 100 MHz to 1300 MHz
- Ac-coupled, 1 megohm input on Channel A, 50 ohm input Channel B
- Continuously variable X1 and X10 wideband attenuator
- Switchable 100 kHz low-pass filter
- Internal metal shielding

The 7220A gives you 10 Hz to 1300 MHz coverage via two separate channels. Channel A is for low-frequency applications (10 Hz to 125 MHz), where the loading of the signal source and the effects of high frequency noise must be minimized. Channel B has a 50 ohm input and is for signals from 100 MHz to 1300 MHz.

An ac-coupled, 1 megohm input and versatile front-end controls for Channel A let you measure signals having extremely high noise levels and still produce stable, accurate readings. A continuously variable X1 to X10 wideband attenuator plus switchable 1X or 10X attenuation lets you minimize noise without losing the signal. And a switchable 100 kHz low-pass filter solves the problem of high frequency contamination of audio frequencies. Used together, the attenuator and filter can solve most noise problems. Electromagnetic interference is greatly reduced with internal metal shielding to meet most of the requirements of U.S. Military Standard MIL-STD-461.

Housed in Fluke's Portable Test Instrument (PTI) case, the 7220A stacks and latches to any other PTI product to become part of a complete, one handle measurement system. The case easily comes apart for servicing.

Resolution Multiplier

Option -351 increases measurement resolution by a factor of 1000 for frequencies from 10 Hz to 10 kHz without requiring any more measurement time. Resolution goes from 0.0001 Hz for 10 Hz signals to 0.1 Hz for 10 kHz signals.

Ovenized Accuracy with Battery Portability

With Option -010, the 7220A may be operated away from ac line power. The internal rechargeable battery pack will provide power for 5½ hours for typical operation. For demanding field applications, the superior accuracy of optional ovenized oscillators assures the highest performance from your counter. These oscillators consume very little power in contrast to conventional ovenized oscillators, so may be used when the 7220A is operating from batteries. And, when you leave the lab on a field assignment, you can switch battery power to the oven to keep the oscillator warm and standing by for measurements with maximum stability and accuracy. There are two low-power oven options to choose from — one (-131) with an aging rate of $\pm 1\times10^{-7}$/month and one (-132) with a superior aging rate of $\pm 5\times10^{-8}$/month. Also there is a low-cost conventional temperature-compensated crystal oscillator (TCXO) for superior accuracy (Option -111).

IEEE-488 Compatibility

Using the Fluke 1120A Translator, a 7220A may be operated in a system configuration with other instruments compatible with IEEE Std 488-1978.

Specifications

Frequency Measurements

Channel A Range: 10 Hz to 125 MHz
Channel B Range: 100 MHz to 1300 MHz
Resolution: 0.1 Hz to 100 Hz in decade steps
Accuracy: ±1 count ± timebase error*
Display: MHz
Burst Mode: Minimum burst equals gate time +40 ms

Channel A Input Characteristics

Bandwidth: 10 Hz to 125 MHz, ac-coupled
Sensitivity: 10 mV rms, 10 Hz to 50 MHz; 15 mV rms, 50 MHz to 100 MHz; 15 mV rms, 100 MHz to 125 MHz
Impedance: 1 MΩ, <60 pF
Filter: 100 kHz, low-pass
Attenuation: X1 to X100; X1 or X10 fixed, plus X1 to X10 continuously variable
Maximum Input: 250V rms from 10 Hz to 5 kHz decreasing linearly from 250V rms at 5 kHz to 5V rms at 2 MHz; 5V rms from 2 MHz to 125 MHz

Channel B Input Characteristics

Bandwidth: 100 MHz to 1300 MHz
Sensitivity: 5 mV rms, 100 MHz to 600 MHz; 10 mV rms, 600 MHz to 1000 MHz; 40 mV rms, 1000 MHz to 1300 MHz
Impedance: 50Ω
VSWR: 2.5:1, maximum
Maximum Input: 5V rms

External Timebase

Frequency: 10 MHz
Sensitivity: 300 mV rms
Input Impedance: 1 kΩ shunted by 30 pF, ac-coupled
Maximum Input: 3V rms
Output: TTL-level 10 MHz squarewave, 200Ω, nominal

Timebase Characteristics

	Option			
Characteristics	**Standard**	**-111 TCXO**	**-131 Oven**	**-132 Oven**
Frequency	10 MHz	10 MHz	10 MHz	10 MHz
Aging Rate (Const. Temp)	$\pm 5\times10^{-7}$/mo	$\pm 3\times10^{-7}$/mo $\pm 1\times10^{-6}$/yr	$\pm 1\times10^{-7}$/mo*	$\pm 5\times10^{-8}$/mo* $\pm 3\times10^{-9}$/day*
Temperature Accuracy (0°C to 40°C)	$<5\times10^{-6}$**	$\pm 1\times10^{-6}$	$\pm 1\times10^{-7}$	$\pm 3\times10^{-8}$
Line Variation (±10% change)	$\pm 1\times10^{-7}$	$\pm 2\times10^{-7}$	$\pm 2\times10^{-8}$	$\pm 4\times10^{-9}$
Battery Operation	$\pm 1\times10^{-7}$	$\pm 2\times10^{-8}$	$\pm 5\times10^{-8}$	$\pm 1\times10^{-8}$
Warm-up*** 10 Minutes 20 Minutes	 — —	 — —	 $\pm 5\times10^{-7}$ $\pm 3\times10^{-8}$	 $\pm 5\times10^{-7}$ $\pm 3\times10^{-8}$

**After five days of continuous operation*
***Includes temperature variations during operation*
****Compared to frequency 24 hours after turn on*

COMMUNICATIONS COUNTER

7220A

Option Specifications

Battery Pack Option (-010)

Type: Nickel-Cadmium, size F
Operating Time: 5½ hours, typical operation
Charge Time: 16 hours at room temperature
Charge Protection: Thermistor-actuated shutdown of charging circuit if battery temperature is too high
Discharge Protection: Automatic shutdown prevents over-discharge

PTI Interface (-521)

Type: Serial BCD output of all 9 digits, decimal, and measurement units

Personality Card Option (-522K)

For 1120A IEEE-488 Translator. Part of Option -529

IEEE-488 Interface Option (-529)

Description: Interfaces the 7220A to IEEE-488 bus via the Fluke 1120A IEEE-488 Translator. (1120A purchased separately). Provides full measurement output capability
Repertoire: SH1, AH1, T5, L4, SR1, RL2, DC1, DT1

Resolution Multiplier Option (-351)

Description: Frequency-locked loop circuit designed to increase low frequency resolution 1000 times
Range: 10 Hz to 10 kHz
Lock Time: 1.5 seconds
Resolution: 0.0001 Hz to 0.1 Hz in decade steps
Accuracy: ±2 counts ± timebase accuracy*

**See timebase characteristics for timebase accuracy*

General Specifications

Display: Nine-digit LED
Self-Check: Counts and displays 10 MHz clock
EMI: Internal metal RFI shield meets most requirements of MIL-STD-461, notice 3
Safety: Designed to meet requirements of UL 1244 and IEC 348
Power: 100V, 120V, 220V, 240V ac ±10% switch-selectable, 47 Hz to 63 Hz, 24VA maximum
Size: Style C PTI case, 32.7 cm L x 20.3 cm W x 10.8 cm H (12.9 in x 8.0 in x 4.3 in)
Weight: 3.2 kg (7 lb)
Included: Instruction manual, power cord. Order Y9111 or Y9112 coaxial cable(s) separately

Model

January 1986 prices

7220A 1300 MHz Frequency Counter	$1365

Options

72XXA-010* Rechargeable Battery Pack	435
7220A-111* 1 ppm TCXO	190
72XXA-131* Low-power Oven	295
72XXA-132* Superior Low-power Oven	545
7220A-351* 1000X Resolution Multiplier	105
72XXA-521** PTI Interface w/PTI Cable	190
72XXA-522K Personality Card, for 1120A	215
72XXA-529[1] Interface for IEEE-488 bus	375

** Factory or Service Center installation only*

*** Factory option only*

[1] *This option can only be used in conjunction with the Fluke 1120A IEEE-488 Translator, purchased separately. Includes 72XXA-521, 72XXA-522K, and 2 ft ribbon cable (Y7203). The -529 Option can be ordered and installed at time of manufacture only. For existing instruments which do not have the -529 Option installed, an IEEE interface can be added by ordering -521 and -522K Options (1120A also required). The -521 Option must be installed at a Factory Service Center.*

Accessories (Also see page 230)

1120A IEEE-488 Translator	550
A53 Whip Antenna	30
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω	20
Y9112 6 ft (1.85m) Coaxial Cable, 50Ω	20
Y9103 50Ω Feed-thru Terminator	35
Y2014 5¼" Rack Adapter, Single	90
Y2015 5¼" Rack Adapter, Double	90
Y2020 Panel Mounting Kit	90
Y7203 2 ft PTI Ribbon Cable	50
Y7204 5 ft PTI Ribbon Cable	65
Y2023 PTI Accessory Case	125

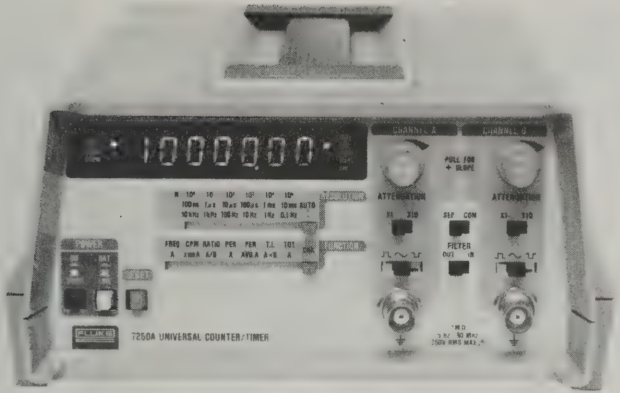
After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

IEEE-488

UNIVERSAL COUNTER/TIMER

7250A



7250A

7250A Universal Counter/Timer

- Frequency to 80 MHz
- Time intervals from 100 ns to 99,999.99 sec
- Period average range 1 ps to 999,999.9 ms
- Autorange
- Internal stainless steel shield

The 7250A Counter is the lowest priced model in the Portable Test Instrumet (PTI) series. Its construction and features are much like those of the 7260A and 7261A.

The instrument will measure frequency to 80 MHz, time intervals down to 100 ns, and periods down to 100 ns with 1 ps resolution (in the average mode). In addition it will measure the ratio of two signal frequencies, counts per minute, or totalize events to 9,999,999 counts.

Simple Operation

The 7250A lets you keep your hands and mind on the job instead of on the counter controls. Select the measurement function you want, set the resolution switch to AUTOrange and the 7250A will automatically choose the correct range for best resolution with up to 7-digit display. It will then position the decimal point properly and light an annunciator LED to inform you of the unit of measurement.

Controls You May Need

A broadband, continuously variable, x100, analog attenuator lets you add just enough attenuation to minimize the input signal noise level and optimize the signal amplitude for counting. A switchable 100 kHz, lowpass filter solves the problem of high frequency contamination of aduio frequency signals. You can use the filter and attenuator separately or in combination to solve tough noise problems, like calibrating audio oscillators near high power rf transmitters. For timing measurements, there are ±slope controls, fixed-offset trigger level switches, and a separate/common switch at your fingertips.

Take It to the Job

The rugged case, compact design, and optional rechargeable battery pack means you can take the 7250A with you to solve those tough field service problems, with no sacrifice in performance. You can operate the counter continuously for up to 3.5 hours before recharging. And battery protection is foolproof. A relay provides positive protection against over-discharge and a thermistor sensor protects against charging when the batteries are too hot.

Laboratory Accuracy in the Field

For applications demanding the best possible accuracy, optional ovenized oscillators are available. They consume very low power in contrast to conventional oscillators, so they can even be used when the 7250A is operating from batteries. When you go out on a field assignment, switch battery power to the oven before leaving and you will arrive with laboratory accuracy with a warm-up.

Low Electromagnetic Interference

A lightweight, internal, stainless steel shield surrounds the instrument and mates with the metal front and rear panels to provide an enclosure meeting most requirements of MIL-STD-461. This means low susceptibility in high-rf environments as well as minimal radiated energy to interfere with nearby rf-sensitive equipment.

IEEE-488 Compatibility, PTI Package

The 7250A incorporates the Fluke-developed portable test instrument (PTI) packaging concept which lets you easily configure low cost, convenient mini-test systems using the Fluke 1120A IEEE-488 Translator. The 7250A is rack-mountable with the 1120A when used with other equipment compatible with IEEE Std 488-1978.

Specifications

Frequency Measurements (CH A)

Range: 5 Hz to 80 MHz, ac coupled
Resolution: 0.1 Hz to 10 kHz, in decade steps
Accuracy: ±1 count ± timebase error*
Display: kHz or MHz with decimal

**See Timebase Characteristics chart*

Period Measurements (CH A)

Range: 100 ns to 99,999.99 seconds
Frequency Range: 5 Hz to 1 MHz
Resolution: 10 ms to 100 ns in decade steps
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms, or sec with decimal

Period-Average Measurements (CH A)

Range: 1 ps to 999,999.9 μs
Frequency Range: 5 Hz to 1 MHz, sinewave
Resolution: 100 ns to 1 ps in decade steps
Accuracy: ±100 ns ÷ N* ± timebase error ± trigger error ÷ N*
Display: μs or ms with decimal

**N = 10^0 to 10^5 in decade steps set by resolution switch. Indicates the number of periods averaged in period average mode, the number of intervals averaged in time interval average mode, or the number of cycles of B averaged in ratio mode.*

Time-Interval Measurements (CH A/CH B)

Range: 100 ns to 99,999.99 sec
Frequency Range: 5 Hz to 1 MHz
Resolution: 100 ns to 10 ms in decade steps
Accuracy: ±1 count ± timebase error ± trigger error
Display: ms or sec with decimal

Totalize

Range: 5 Hz to 80 MHz for channel A
Count Capacity: 9,999,999
Display: Digits only, no decimal or annunciator

Ratio Measurements

Range: 5 Hz to 80 MHz for channel A, 5 Hz to 1 MHz for Channel B
Resolution: ± frequency of B ÷ (N* x frequency of A)
Accuracy: ±Resolution ±(frequency of B x trigger error of B ÷ N*)
Display: Digits with decimal, no annunciator

IEEE-488

UNIVERSAL COUNTER/TIMER

7250A

Counts Per Minute (cpm x 100,* CH A)

Range: 5 Hz to 80 MHz
Count Time: 600 ms (1/100 minute)
Resolution: 100 cpm, fixed
Accuracy: ± 1 count ± timebase error
Display: Digits only, no decimal or annunciator
**Reads RPM direct of 100-tooth wheel/sensor*

Channel A & B Input Characteristics

Selection: Separate or A connected to B (Sep/Com)
Sensitivity: 10 mV rms 5 Hz to 50 MHz, 15 mV rms, 50 MHz to 80 MHz*
Impedance: 1 MΩ, 50 pF, nominal
Coupling: ac only
Attenuator: X 1 X 100, continuously variable
Filter:1 Low pass, 100 kHz 3 db point, nominal
Trigger Level: +150 mV, 0V, or -150 mV, switch-selectable
Maximum Input: 100V rms 5 Hz to 45 Hz, 250V rms 45 Hz to 50 kHz decreasing to 5V rms at 1 MHz, 5V rms 1 MHz to 80 MHz

External Timebase Input

Frequency: 10 MHz, ac coupled
Sensitivity: 300 mV rms
Impedance: 1 kΩ, 30 pF, nominal
Maximum Input: 3V rms

Timebase Characteristics

Same as for 7260A & 7261A

Option Specifications

Battery Pack Option (-010)

Type: Nickel-Cadmium, size F
Operating Time: 3.5 hours continuous, decreasing to 3 hours, typical worst case with Option -131 or -132 ovenized oscillators installed
Charge Time: 16 hours at room temperature
Charge Protection: Thermistor-actuated shutdown of charging circuit if battery temperature exceeds 65°C
Discharge Protection: Automatic low-voltage shutdown to prevent over discharge

PTI Interface (-521)

Type: Serial BCD output of all 7 digits and measurement units
Levels: TTL, "1" state low

Personality Card Option (-522K)

For 1120A IEEE-488 Translator. Part of Option -529

IEEE-488 Interface Option (-529)

Description: Interfaces the 7250A to IEEE-488 via the Fluke 1120A IEEE-488 Translator. (Note: 1120A must be purchased separately.) Provides full measurement output capability, and limited triggering and reset of a measurement
Repertoire: SH1, AH1, L4, SR1, RL2, DC1, DT1

General Specifications

Display: 7-digit LED with leading zero suppression, decimal, and annunciators
Cycle Rate: Fixed 250 ms between readings
Reset: Reset button clears display, lights all display segments and, on release, activates a new measurement
Self Check: Counts and displays 10 MHz clock
Temperature: 0°C to 40°C, operating; −40°C to +70°C, non-operating
EMI: Internal metal RFI shield meets most requirements of MIL-STD-461, Notice 3
Safety: Designed to meet requirements of UL 1244 and IEC 348
Power: 100V, 120V, 220V or 240V ac ±10%, 47 to 63 Hz, 32 VA max.
Size: 32.7 cm L x 20.3 cm W x 10.8 cm H (12.9 in L x 8.0 in W x 4.3 in H)
Weight: 3 kg (6.5 lbs)
Included: Instruction manual, power cord. Order Y9111 or Y9112 coaxial cable(s) separately

Model

January 1986 prices

7250A Universal Counter/Timer	$1040

Options

72XXA-010* Battery Pack, NiCd Rechargeable	435
72XXA-112* TCXO, 2 ppm	245
72XXA-131* Low Power Oven	295
72XXA-132* Superior Low Power Oven	545
72XXA-521** PTI Interface w/PTI Cable	190
72XXA-522K Personality Card	215
72XXA-529' IEEE-488 Interface	375

** Factory or Service Center installation only*
*** Factory option only*
' Includes parts needed to interface the 7250A to IEEE-488. Parts can only be used in conjunction with Fluke 1120A IEEE-488 Translator. Includes 72XXA-521, 72XXA-522K, and Y7203 2 ft. ribbon cable. The -529 Option can be ordered and installed at time of manufacture only. For existing instruments which do not have the -529 Option installed, an IEEE interface can be added by ordering -521 and -522K Options (1120A also required). The -521 Option must be installed at a Factory Service Center.

Accessories (Also see page 230)

1120A IEEE-488 Translator	550
A53 Whip Antenna	30
Y7201 Attenuator/Filter	65
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω	20
Y9112 6 ft (1.85m) Coaxial Cable, 50Ω	20
Y9103 50Ω Feed-thru Terminator	35
Y2014 5¼" Rack Adapter, Single	90
Y2015 5½" Rack Adapter, Double	90
Y2020 Panel Mounting Kit	90
Y7203 2 ft PTI Ribbon Cable	50
Y7204 5 ft PTI Ribbon Cable	65
Y2023 PTI Accessory Case	125

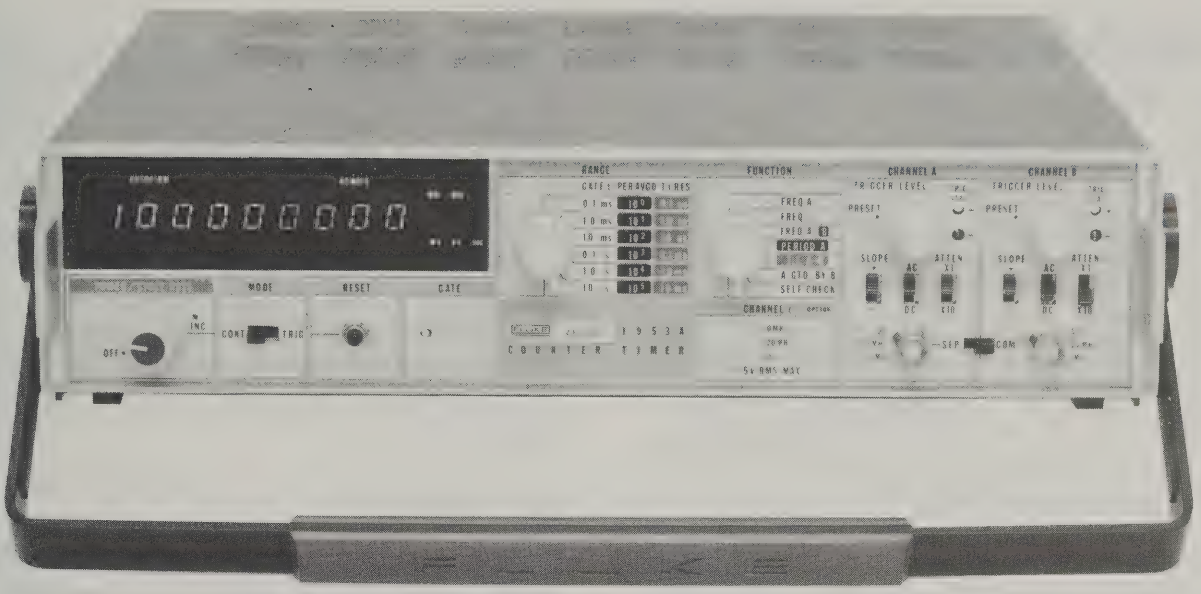
After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

IEEE-488

UNIVERSAL COUNTER/TIMER

1953A



1953A

1953A Universal Counter/Timer

- Frequency, frequency ratio, period, period averaging, time interval, gated totalize measurements
- 9 digit display
- Trigger level controllable on both channels
- Selectable + or — slope triggering, ac or dc coupling, X1 or X10 attenuation
- Switch selection of separate or common input between channels

The 1953A is Fluke's sophisticated system counter which has an outstanding price/performance ratio and a wide array of options which allow you to select just the capability you need to solve your specific measurement problems.

Features

The standard instrument features all the basic functions required for a variety of measurements: frequency, frequency ratio, period, period averaging, time interval, and gated totalize. Wide-ranging provides six choices of gate times, period averages, and time interval resolutions. The 1953A counts to 125 MHz, higher with Option -07, -13, or -14

The trigger-level controls for channels A and B allow the user to select a preset trigger level (0V dc) or to vary the level at which the input signal will trigger the counter. Two LED trigger status indicators operate in conjunction with each level control to show whether the counter is correctly triggered or when the input is more positive or negative with respect to the selected trigger level (see diagram). Two output jacks allow a DMM to be used to set the levels accurately.

Three signal conditioning switches are provided for each channel permitting the operator to select positive or negative slope triggering, ac or dc coupling, and XI or X10 attenuation.

Dual input channels are direct coupled with 30 mV sensitivity. A switch for selection of separate or common input between channels is provided to allow input of either a single source common to both channels or two separate sources each on a separate channel. This is particularly useful in time interval measurements. A TTL marker pulse output permits accurate determination of the start and stop signal trigger points. By connecting this marker pulse to an oscilloscope Z-axis input, the portion of the waveform displayed on the oscilloscope during the time interval measured will be intensity modulated

A display check lights all digit segments when the reset button is pressed with the counter in self-check mode. A large, easy-to-read 9-digit LED display includes full leading zero suppression, automatic annunciation, and overflow.

Options

Three 50Ω input prescalers are available to extend frequency measurement capability from 0 to 125 MHz (standard) to 520, 1000 or 1250 MHz. A superior TCXO and two oven stabilized timebases provide higher accuracy measurements. Available to systems oriented users is a choice of three remote programming options, two of the fast parallel controlled type and one using the bi-directional IEEE-488 interface. A separate parallel data output option is available for digit, decimal point, overflow, and units annunciation information for data acquisition use. All options are TTL compatible.

IEEE-488 Interface Option

This interface permits interconnection with bus-compatible Fluke instruments and those of other manufacturers having the standard interface. The Fluke IEEE Interface Option (−15) is intended for systems applications where bus management and data manipulation are performed via a system controller (terminal, calculator, computer, etc.). The counter can also be manually operated without the use of a controller, displaying measurement information locally and outputting data (talk only mode) directly to a printer, display terminal or other peripheral device.

The 1953A Option −15 is compatible with the IEEE Interface standard using the preferred ASCII (U.S.A. Standard Code for information interchange) character-serial, seven bit code set. Interface driver and receiver circuits are all TTL compatible which permits remote operation of the counter's function, range, and signal conditioning, with front panel lockout.

Output information is comprised of 9 display digits, decimal point, and exponent for frequency or time units. Overflow indication is provided beyond a display of 10^9.

Two internal D/A converters are included for remote programming of the A and B channel trigger levels. Each provides 1% resolution.

UNIVERSAL COUNTER/TIMER

1953A

Specifications

Frequency Measurements

Range: 0 to 125 MHz (dc coupled) 5 Hz to 125 MHz (ac coupled). Prescalers to 1250 MHz (Options –07, –13, –14). All prescalers have clean dropout to eliminate false readings
Gate Time: 0.1 ms to 10s in 6 decade steps (prescaled input increases gate time by a factor of 4 or 8)
Resolution: 0.1 Hz at 10s gate time to 10 kHz at 0.1 ms gate time
Accuracy: ± Timebase accuracy ±1 count
Readout: kHz or MHz displayed with decimal point

Period Measurements

Range: 0 to 25 MHz (dc coupled), 5 Hz to 25 MHz (ac coupled)
Periods Averaged: 1 period to 10^5 periods in decade steps
Clock Frequency: 10 MHz
Resolution: 0.1 μs at 1 period to 1 ps at 10^5 periods
Accuracy: Timebase accuracy ±1 count + trigger error of signal on input A*
Readout: ms or μs automatically displayed with decimal point
**See Timebase Characteristics chart*

Time Interval Measurements

Range: 0.1 μs to 10^7s
Input: Channels A and B; common or separate
Resolution: 10 ms to 0.1 μs in 6 decade steps
Accuracy: ±1 count + timebase accuracy + trigger error*
Readout: ms or s automatically displayed with decimal point
**See Timebase Characteristics Chart*

Totalize Measurements

Totalizing: A gated by B
Range: 0 to 125 MHz (dc coupled), 5 Hz to 125 MHz (ac coupled)
Readout: Counts without annunciation or decimal point

Ratio Measurements

Display: f1/f2, where f1 and f2 are applied at input channels A and B respectively
Range:
f1: 0 to 125 MHz (dc coupled), 5 Hz to 125 MHz (ac coupled)
f2: 0 to 25 MHz (dc coupled), 5 Hz to 25 MHz (ac coupled)
Accuracy: ±1 count of signal on input A + trigger error of signal on input B*
Readout: Decimal point without unit annunciation
**See Timebase Characteristics chart*

Sensitivity

Channel A: 30 mV rms sinewave from dc to 75 MHz increasing to 50 mV at 125 MHz; 100 mV pulse amplitude with minimum pulse width of 10 ns
Channel B: 30 mV rms sinewave from dc to 25 MHz; 100 mV with minimum pulse width of 50 ns
Channel C: See Option –07, –13, –14

Input Impedance

Channel A or B: 1 MΩ, ≤30 pF
Channel C: 50Ω nominal

Attenuator & Limiting

Channel A and B only: Sensitivity is decreased by a factor of approximately 10 in the X10 position
Dynamic Range w/o Limiting: –3.5 to +3.5V (Channel A and B) 1V rms (Channel C)
Impedance in Limiting Condition: 120 kΩ in parallel with 75 pF (Channel A and B). VSWR less than 3:1 (Channel C)

Slope & Trigger Level

Channel A and B only: Front panel slide switch selects positive or negative slope triggering. Front panel control has ±1V range when attenuator is in X1 position, and ±10V in the X10 position
Maximum Input Voltage: Channel A & B — 250V max dc + ac peak, 150V rms to 1 kHz; 5V rms to 125 MHz; Channel C — 5V rms, fuse protected
Trigger Level Output: Channel A & B trigger levels available at rear panel BNC connectors

Timebases

	Standard	-04 Option	-10 Option	-20 Option
Frequency	10.00 MHz	10.00 MHz	10.00 MHz	10.00 MHz
Aging Rate (Constant Temperature)	$\pm 3\text{x}10^{-7}$/mo 1 ppm/yr	$\pm 3\text{x}10^{-7}$/mo 1 ppm/yr	$\pm 1\text{x}10^{-7}$/mo	$\pm 1.5\text{x}10^{-8}$/mo
Temperature Accuracy 0°C-50°C	$\pm 2\text{x}10^{-6}$	$\pm 5\text{x}10^{-7}$	$\pm 1\text{x}10^{-8}$	$<7\text{x}10^{-9}$†
Line Voltage (±10%)	$\pm 2\text{x}10^{-8}$	$\pm 2\text{x}10^{-8}$	$\pm 3\text{x}10^{-9}$	$\pm 1\text{x}10^{-9}$

* *Trigger error of channels A or B is less than ±0.3% of one period ÷ periods averaged for signals with better than 40 dB signal to noise ratio and 100 mV rms amplitude*

** *Trigger error in time interval mode is less than ±0.0025/signal slope (V/μs) in μs*

† *Peak to peak variation*

External Timebase Input

Frequency Required: 10 MHz
Sensitivity: 250 mV
Impedance: 1 kΩ, 20 pF
Dynamic Range w/o Limiting: 8V peak to peak
Input Impedance During Limiting: 470Ω in parallel with 30 pF

Option Specifications

Digital Output Unit (–02)

Provides BCD TTL outputs from each digit, plus overflow, units annunciation, decimal point, and print command.

Superior TCXO (–04)

See timebase specifications above

Timebase Multiplier (–05)

Allows use of external 1, 5, or 10 MHz reference clock (standard unit accepts 10 MHz). This option also permits burst measurements to be made when a "level" signal is available if burst is longer than 100 μs

Oven Stabilized Timebase (–10)

Oven is activated whenever instrument is connected to the AC line. See timebase specifications above

Basic Parallel Remote Programming (–11)

Allows single-line programming (TTL or contact closure) of range, mode, slope, and reset functions. Allows analog programming of trigger levels, and provides power sense, overflow status, and system ready outputs. Front panel lockout is provided

Full Parallel Remote Programming (–12)

Includes all the features of Option –11, plus programming of ac or dc coupling, attenuation, separate/common, and digital trigger level. Trigger level of channels A and B is programmable over a +1V to –1V range (2 BCD digits plus sign), giving a resolution of 1%, and an accuracy of 5% plus 2 mV (1 year). Temperature stability is better than 200 μV/°C. Two analog input/output lines are provided for either checking the D/A performance, or programming via analog levels. Option –12 increases input capacitance to 37 pF maximum

IEEE–488 Interface (–15)

Full remote programming of function, range, and all signal conditioning controls including trigger, coupling, slope, attenuator, and level. Directly compatible with IEEE-488-1978 Interface Standard. Data output includes 9 digits of display information, decimal point, and exponent for time or frequency units. Front panel lockout is provided. Ask for Application Bulletin 23.

Rear Inputs (–16)

Two rear inputs in parallel with A and B front inputs (capacity 85 pF) plus a rear input for channel C (decreased sensitivities)

Superior Oven-Stabilized Timebase (−20)

Oven is activated whenever instrument is connected to the AC line. See timebase specifications

520 MHz Channel C Input (−07)

Covers frequency range of 50 to 520 MHz, using a scaling ratio of 4. Sensitivity is 15 mV rms (AGC). Maximum allowable input is 5V rms (fuse protected). VSWR less than 2:1 into 50Ω for levels less than 1V rms

1000 MHz Channel C Input (−13)

Covers 50 to 1000 MHz using a scaling ratio of 8. Sensitivity is 15 mV rms, and maximum allowable input is 5V rms (fuse protected). VSWR is less than 2.5:1 for levels less than 1V rms.

1250 MHz Channel C Input (−14)

Covers 50 to 1250 MHz using a scaling ratio of 8. Sensitivity is 15 mV to 1000 MHz, decreasing to 30 mV rms at 1250 MHz. Maximum input is 5V rms (fuse protected). VSWR is less than 2.5:1 (50Ω) for levels less than 1V rms

General Specifications

Display: 9-digit LED display with large 7-segment characters. Full leading zero suppression
Cycle Rate: In "CONT" mode, the time interval between successive measurements can be varied by means of a cycle rate control between approximately 0.2 and 2.0s. "Reset" button clears display and activates a new measurement
Reset: In "TRIG" mode, readings may be updated by pushing the "Reset" button or by grounding the external reset pin on the remote control connector. With external reset the display is not cleared
Self-Check: A timebase-derived 10 MHz signal is internally counted
Gate Time: High True, TTL level output
Time Interval Marker: Low True, TTL level output
Temperature: 0°C to +50°C, operating; −40°C to +75°C, non-operating
Power: 115 or 230V ac ±10% (100V operation available), 50 to 400 Hz, 30W nominal
Size: 8.8 cm H x 36.2 cm W x 34.3 cm D (3.45 in H x 14.25 in W x 13.5 in D)
Weight: 4.32 kg (9.5 lb)
Included: Instruction manual, power cord. Order Y9111 or Y9112 coaxial cable(s) separately

Model

January 1986 prices

1953A Universal Counter/Timer	$1750

Options

1953A-02 Digital Output Unit	275
1953A-04* Superior TCXO	285
1953A-05 Timebase Multiplier	110
1953A-07* 520 MHz	545
1953A-10** Oven-Stabilized Timebase	435
1953A-11** Basic Remote Programming	325
1953A-12** Full Remote Programming	645
1953A-13* 1000 MHz	655
1953A-14* 1250 MHz	870
1953A-15*** IEEE-488 Interface	540
1953A-16** Rear Inputs	85
1953A-20** Superior Oven-Stabilized Timebase	820

* *Factory or Service Center installation only*
** *Factory option only*
*** *Also factory option only. Cannot install with -02, -11, or -12*

Accessories (Also see page 230)

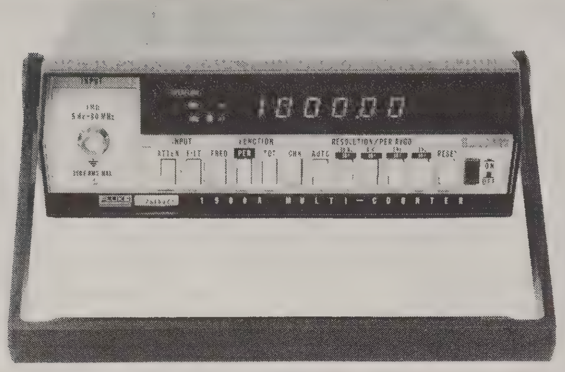
A53 Whip Antenna	30
Y7201 Attenuator/Filter	65
M00-200-622 3½" Rack Adapter	65
M00-200-626 3½" Rack Adapter w/slides, for DEC cabinets	135
Y7206 3½" Adapter w/slides, for non-DEC cabinets	110
Y8021 1m Cable, IEEE-488 bus	85
Y8022 2m Cable, IEEE-488 bus	95
Y8023 4m Cable, IEEE-488 bus	105
Y9103 50Ω Feed-thru Terminator	35
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω	20
Y9112 6 ft (1.85m) Coaxial Cable, 50Ω	20

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

MULTIFUNCTION COUNTER

1900A **Available through Distributors (See page 248)**



1900A

1900A Multifunction Counter

- Frequency, period, period averaging & totalize measurements
- 6-digit display
- 1 MHz low-pass filter
- Available with full parallel BCD output and rechargeable battery

Fluke's versatile 1900A Multi-Counter provides frequency, period, period averaging, and totalize measurements over a wide range of applications. In frequency mode, the 1900A verifies the accuracy of signal sources such as generators, oscillators and transmitters. Period mode measures the time duration of a single input cycle, which allows high resolution of low frequency measurements. In period average mode, the counter averages cycle time over 10, 100 or 1000 cycles for still finer resolution. Totalize mode is similar to frequency mode except that the signal gate is open and closed deliberately, a feature useful for totalizing the cycles in a single RF burst or counting electromechanical relay contact bounce. A selectable 1 MHz low-pass filter provides input signal conditioning to give accurate low frequency measurements in electrically noisy environments. A selectable 10:1 attenuator is provided.

A rechargeable battery is included in Model 1900A–01, providing up to 4 hours of operation with a 14 hour recharge time.

Digital data plus decimal point and annunciator data is available in Model 1900A–02. The full parallel BCD output in Model 1900A-02 is CMOS and TTL compatible and print command is provided.

Specifications

Frequency: 5 Hz to 80 MHz. Four manually-selected gate times of 10 ms (100 Hz resolution), 100 ms (10 Hz resolution), 1s (1 Hz resolution), and 10s (0.1 Hz resolution). Autorange position automatically seeks to fill all 6 digits but will not select a gate time greater than 1s (1 Hz resolution)

Period: 5 Hz to 1 MHz. Manual selection of single period or 3 period-averaging ratios:

10^0 single period (100 ns resolution)
10^1 periods averaged (10 ns resolution)
10^2 periods averaged (1 ns resolution)
10^3 periods averaged (100 ps resolution)

Autorange position automatically seeks to fill all 6 digits but will not select a period average of greater than 10^2 averages

Totalizing: Accumulates up to 999999 counts, then activates overflow indicator

Sensitivity: 25 mV, typically 15 mV rms sinewave, 5 Hz to 80 MHz. Frequency and totalize: 200 mV peak-to-peak pulse amplitude with minimum pulse width of 20 ns. Duty cycle >10%. Period: 200 mV peak-to-peak pulse amplitude with minimum pulse width of 200 ns. Duty cycle >10%

Input Impedance: 1 MΩ, ≤30 pF

Noise Filter: 1 MHz (3 dB point) lowpass

Attenuator: Decreases sensitivity by 10

Overload: 250V rms 5 Hz to 1 kHz decreasing to 20V at 80 MHz

Timebase

Frequency:	10.00 MHz
Aging Rate:	<±5 x 10^{-7}/mo
Temperature Accuracy: 0°C to 50°C	<±5 x 10^{-6}
Line Variation: (±10%)	<±1 x 10^{-7}

Display: 6-digit LED, leading zero suppression. Time between successive measurements is 200 ms plus measurement time.

Annunciation: MHz, kHz, ms, μs, overflow

Autorange: In both frequency and period modes, autoranging includes a unique 20% hysteresis in its switching thresholds to eliminate redundant up-range/down-range commands. This allows measurements to be made on signals containing large amounts of FM and φM. Hysteresis memory can be reset by depressing the "Reset" button

General Specifications

Autoreset: A new measurement sequence is started every time a front panel button is activated

Temperature: 0°C to +50°C operating (40°C max in battery version if being charged while operating); −40°C to +60°C, non-operating

Power: 115 or 230V ac ±10% (100V ac available) 50, 60 or 400 Hz. 6.5W line model, 8.5W battery model

Fuses: 1/8A line version, 1/2 amp slow-blow battery version

Size: 6 cm H x 22 cm W x 25 cm D (2.5 in H x 8.5 in W (including handle) x 10 in D)

Weight: 1.2 kg (2.75 lb), 1.9 kg (4¼ lb) with batteries

Included: Instruction manual, power cord. Order Y9111, Y9112, and Y9103 coaxial cable(s) and 50-Ohm Terminator separately

Models

January 1986 prices

1900A Multifunction Counter	$425
1900A-01** With Rechargeable Battery	490
1900A-02* With Data Output	495

**Factory or Service Center installation only*
***Factory Option only*

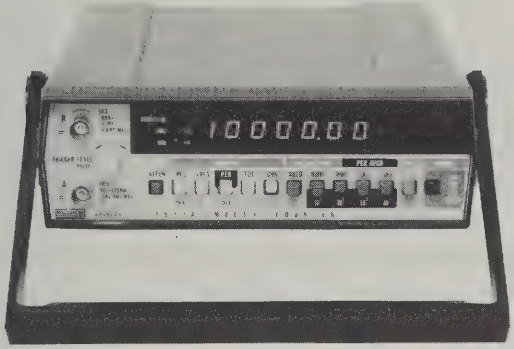
Accessories (Also see page 230)

A53 Whip Antenna	30
C86 Carrying Case, Molded Plastic	20
Y7201 Attenuator/Filter	65
Y8205 Soft Carrying Case w/shoulder strap	35
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω	20
Y9112 6 ft (1.85m) Coaxial Cable, 50Ω	20
Y9103 50Ω Feed-thru Terminator	35
M00-100-714 Dust Cover	10
M00-200-611 3½" Rack Adapter, Offset	35
M00-200-612 3½" Rack Adapter, Center	35
M00-200-613 3½" Rack Adapter, Dual	50

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

1910A



1911A

1912A

1910A/1911A/1912A Multifunction Counters

- Frequency, period, period averaging & totalize measurements
- 7-digit display
- Autoranging
- Autoreset
- Instant warning when input signal falls below sensitivity threshold (Models 1911A and 1912A)
- Rechargeable battery pack version

These rugged counters are at home on the production line, in the lab, or in the field and do the work of counters costing much more. They measure frequencies to 125 MHz, 250 MHz or 520 MHz (depending on model), period of signals to 2 MHz, period average to 10 ps resolution and totalize to 9,999,999 counts.

Autorange

Full autoranging is supplemented by selectable four-range manual operation. In autorange, the display is automatically filled to a maximum 7-digit readout. A unique hysteresis capability eliminates undesirable up-and-down ranging for between-range signals.

Autoreset

This automatic feature is activated every time you select a new range or function, which means you never have to wait for a second reading, the first one in the new measurement sequence is always correct. Autoreset saves time and reduces errors.

Automatic Clean Dropout

The 1911A and 1912A Channel B input has a circuit which automatically monitors the input and gives you instant warning in the form of zero readout whenever your input signal falls below the sensitivity threshold of the trigger circuit. When the signal level returns to an acceptable level, the counter locks on for a correct reading.

Sensitivity

A basic sensitivity of 15 mV, backed by Fluke's conservative design margin, guarantees you will get reliable, solid readings every time. In practice, a typical sensitivity of 10 mV will be experienced.

Versatile Timebases

The standard 0.5 ppm per month timebase assures excellent long term stability for bench, production or field use. A convenient rear panel external timebase input jack and switch let you operate from your own 10 MHz frequency standard at any time. Choice of optional timebases with improved aging rates and temperature stabilities allows you to purchase only as much stability as you'll need in your applications.

Input Signal Conditioning

Each counter offers trigger level and attenuator controls which operate over the dynamic range of the input to permit accurate readings in the presence of noise. Even ringing TTL signals can be accurately measured. In addition, the 1911A offers a separate 50 ohm input for 50 MHz to 250 MHz and the 1912A does the same but goes to 520 MHz.

Battery Portability

All three counters are available with rechargeable batteries for field portability. Order 1910A-01, 1911A-01, or 1912A-01. Four hours minimum operation gives you plenty of opportunity to solve those tough field service problems.

Specifications

Ch. A Attenuator: X1, X10 (approx.)
Ch. A Trigger Level: ±0.5V range
Ch. A Totalize: 1 to 9,999,999 counts
Frequency Accuracy: Timebase accuracy ±1 count
Period Accuracy: Frequency accuracy plus trigger error*

** Trigger error is less than 0.3% of one period ÷ periods averaged for sinewaves of 40 dB signal-to-noise ratio or better and amplitude equal to sensitivity of counter*

Frequency Resolution: 0.1 Hz, 1 Hz, 10 Hz, 100 Hz, manually selected. Autorange automatically seeks to fill 7 digits but will not select gate time >1 second

Period Resolution: 100 ns, 10^0 single period; 10 ns, 10^1 period averaged; 1 ns, 10^2 periods averaged; 100 ps, 10^3 periods averaged. Autorange automatically seeks to fill 7 digits; if input frequency is high enough, may select 10^4 periods averaged (10 ps resolution) but will not select measurement time >1 second

MULTIFUNCTION COUNTERS

1910A/1911A/1912A **Available through Distributors (See page 248)**

Specifications

Model	Channel	Operating Range		Sensitivity	Input Impedance	Overload (Max Input Voltage)	Prescale Factor
		Frequency	Period				
1910A	A	5 Hz - 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15 mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 MΩ/30 pF, ac coupled	dc + ac; <360V pk ac; 250V rms 5 Hz - 1 kHz, 10V rms above 1 kHz	—
1911A	A	5 Hz - 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15 mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 MΩ/30 pF, ac coupled	dc + ac; <360V pk ac; 250V rms 5 Hz - 1 kHz, 10V rms above 1 kHz	—
	B	50 MHz - 250 MHz	—	15 mV rms, 50 MHz - 175 MHz 30 mV rms, 175 MHz - 250 MHz	50Ω, VSWR <2.5:1	dc + ac; <100V ac; 5V rms, fuse protected	2
1912A	A	5 Hz - 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15 mV rms, 5 Hz - 100 MHz 25 mV rms, 100 MHz - 125 MHz	1 MΩ/30 pF, ac coupled	dc + ac; <360V pk ac; 250V rms 5 Hz - 1 kHz, 10V rms above 1 kHz	—
	B	50 MHz - 520 MHz	—	15 mV rms, 50 MHz - 175 MHz 25 mV rms - 520 MHz	50Ω, VSWR <2.5:1	dc + ac; <100V ac; 5V rms, fuse protected	4

Option Specifications

Data Output Option (-02)

Data Output: 7 digits with overflow, decimal point and units information in BCD parallel/byte serial format at CMOS levels
Other Outputs: 7-digit strobe signals, update signal, leading zero suppression signal

TCXO Options (-03, -04)

See Timebase Selection Guide

Timebase Selection Guide

Type (10 MHz)	Aging Rate	Line Variation (±10%)	Temperature Accuracy
			0 - 50°C
Standard	±5 x 10^{-7}/mo	±1 x 10^{-7}	±5 x 10^{-6}*
Option -03	±3 x 10^{-7}/mo	±2 x 10^{-8}	±2 x 10 ^{6}*
Option -04	±3 x 10^{-7}/mo	±2 x 10^{-8}	±5 x 10^{-7}*

**p-p variation*

Y7201 Attenuator/Filter

The Y7201 is a combination variable attenuator and selectable low pass filter which can be used for input signal conditioning on all counters. Typical specifications are:
Input Impedance: 47 kΩ
Attenuation Range: X5 to X100, continuously adjustable
Low Pass Filter: 1 kHz, 20 kHz or 100 kHz, switch-selectable
Maximum Input: 30V AC

General Specifications

Display: 7-digit LED, leading zeros suppressed
Annunciation: MHz, kHz, msec, μsec, overflow
Operating Temperature: 0°C to 50°C (line models). 0°C to 40°C (battery models) when operating and charging
Storage Temperature: −40°C to +70°C (line models). −40°C to +60°C (battery models)
External Timebase Input
  Frequency: 10 MHz to 300 kHz (typical)
  Amplitude: 300 mV rms, 5V p-p max
  Input Impedance: >1 kΩ
Power, Line Models: 100, 115, or 230V ac ±10%, 48 Hz to 440 Hz, 8 W maximum
Power, Battery Models
  100V ±10%, 48 Hz to 52 Hz, 8.5W max
  100V ±10%, 58 Hz to 62 Hz, 8.5W max
  115V ±10%, 58 Hz to 62 Hz, 8.5W max
  230V ±10%, 48 Hz to 52 Hz, 8.5W max
Note: Voltage and frequency must be specified at time of order

Time (between successive measurements): 200 ms plus measurement time
Size: 6.4 cm H x 21.7 cm W x 27.1 cm D (2.52 in H x 8.55 in W x 10.65 in D)
Weight: 1.5 kg (3.2 lb) max, for line models. 2.2 kgm (4.8 lb) max for battery models
Included: Instruction manual, power cord. Order Y9111 or Y9112 coaxial cable(s) separately

Models

January 1986 prices

Model	Price
1910A 125 MHz Multifunction Counter	$595
1910A-01 With Rechargeable Battery	650
1911A 250 MHz Multifunction Counter	695
1911A-01 With Rechargeable Battery	760
1912A 520 MHz Multifunction Counter	865
1912A-01 With Rechargeable Battery	980

Specify line voltage and frequency if other than 60 Hz and 115V ac

Options for 1910A, 1911A, 1912A

Option	Price
1910A-02* Data Output	50
1910A-03** 2 ppm TCXO	170
1910A-04** 0.5 ppm TCXO	285

**Not compatible with battery models. Factory option only.*
***Factory option only*

Accessories (Also see page 230)

Accessory	Price
A53 Whip Antenna	30
Y7201 Attenuator/Low Pass Filter	65
Y9111 3 ft (0.93m) Coaxial Cable, 50Ω	20
Y9103 50Ω Feed-thru Terminator	35
C86 Carrying Case, Molded Plastic	20
Y8205 Soft Carrying Case w/shoulder strap	35
M00-200-611 3½" Rack Adapter, Offset	35
M00-200-612 3½" Rack Adapter, Center	35
M00-200-613 3½" Rack Adapter, Dual	50

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

CALIBRATION PRODUCTS

What is Calibration?

Calibration is a special, highly-refined measurement process in which you compare test and measurement instruments of unknown status to well-defined standards of greater accuracy in order to detect, eliminate by adjustment, and report any variations in accuracy or capability. In other words, it is a process verifying the operational integrity of instruments. It provides two major benefits. First, it allows you to use your instruments with confidence by minimizing the uncertainties associated with them. Second, it fulfills the requirements for "traceability" to national standards demanded so frequently today.

Calibrators

Model	Direct Voltage (dV)	Alternating Voltage (aV)	Direct Current (dI)	Alternating Current (aI)	Resistance	Wideband	Basic Uncertainty	IEEE-488	Page
335A	To 1110V	—	—	—	—	—	20 ppm	No	106
335D	To 1110V	—	—	—	—	—	10 ppm	No	106
343A	To 1100V	—	—	—	—	—	20 ppm	No	107
515A	To 100V	To 100V	—	—	10Ω to 10 MΩ	—	30 ppm	No	105
5100B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	50 ppm	Option	97
5101B	To 1100V	To 1100V	To 2A	To 2A	1Ω to 10 MΩ	Option	50 ppm	Option	97
5200A	—	To 120V	—	—	—	—	200 ppm	Option	101
5440B	To 1100V	—	—	—	—	—	3 ppm	Yes	94
5442A	To 1100V	—	—	—	—	—	4 ppm	Yes	94
5450A	—	—	—	—	1.0Ω to 100 MΩ	—	8 ppm	Yes	104
7105A	To 1100V	—	—	—	—	Resistance Ratio	4 ppm	No	108

Amplifiers

Model	Output Range	Compatible Calibrators	Gain/ Transcond.	AC-Coupled	DC-Coupled	Page
5205A	1200V rms 1600V dV	5100B 5101B 5102B 5200A 5440B	100	Yes	Yes	111
5215A	1200V rms	5200A	100	Yes	No	113
5220A	To 20A	5100B 5101B 5102B 5440B	1A/V	—	Yes	115

Reference Standards

Model	Stability (Amplitude)	dV	aV	Frequencies	DVMP*	Page
510A	±0.005 % in 30 Days	—	10V rms	50 Hz to 100 kHz	No	125
731B	10 ppm	10V 1V 1.018V △V	—	—	No	122
732A	0.5 ppm	10V 1V 1.018V	—	—	Yes	119

**Direct Voltage Maintenance Program*

Computer-Aided Calibration

Model	Oscilloscope Calibration	Multimeter Calibration	Bench or Rack	Measurement Capability	Page
7404B	—	Yes	Bench	Yes	133
7405A	—	Yes	Rack	Yes	138
7410A	Yes	—	Rack	Yes	140
7411A	Yes	Yes	—	Yes	131
7449A	Yes	Yes	Bench	Yes	136
A123	—	Yes	—	Yes	144

Dividers and Auxiliary Equipment

Model	Basic Uncertainty	Stability	Input Range	Page
Y5020	±0.01%	0.002% in 6 months	0 to 20A	116
720A	0.1 ppm	1.0 ppm/ year	0 to 1100V	123
721A	—	—	4000:1 Ratio	122
750A	10 ppm	10 ppm/year	1.1 to 1100V	123
752A	0.2 ppm - 10:1 0.5 ppm - 100:1	—	1100V	120
845AB	2%	0.15 μV/HR	1.0 μV to 1000V	124
845AR	3%	0.15 μV/HR	1.0 μV to 1000V	124

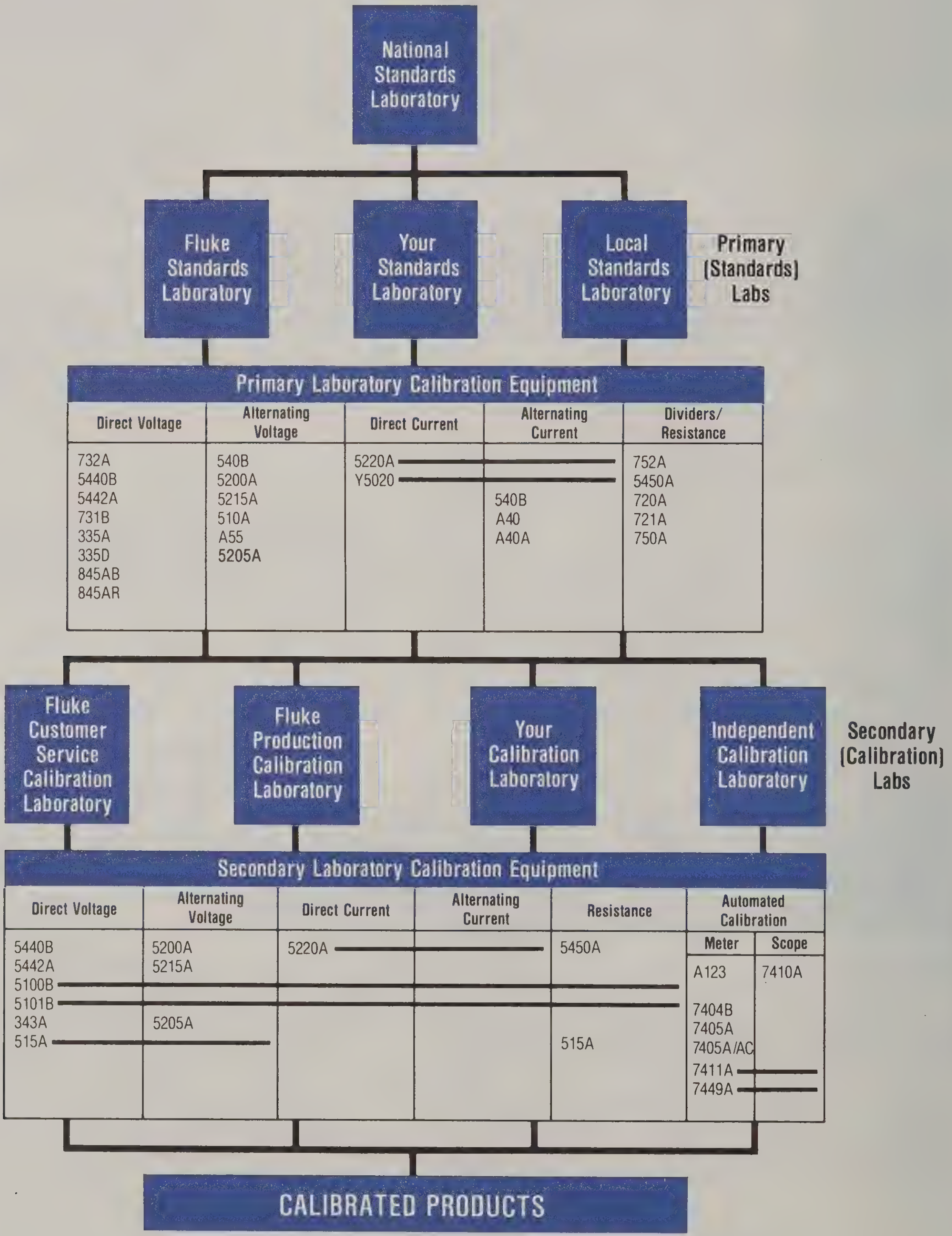
AC/DC Transfer Standards

Model	Volts	Current	AC/DC Difference	Frequency Range	Page
A40	—	10 mA to 5A	0.02% with 540B	5 Hz to 100 kHz	126
A40A	—	10A and 20A	0.03% with 540B	5 Hz to 50 kHz	126
A55	0.5 to 50V	—	0.05% to 0.5%	1 MHz to 50 MHz	127
540B	To 1000V	With A40, A40A	0.01%	5 Hz to 1 MHz	125

APPLICATIONS

Using the Applications Road Map to Calibration

The chart below shows the traceability chain and how Fluke calibration products are used. Products are shown as having applications in primary standards labs, secondary calibration labs, or both. Fluke also has a variety of automated, computer-aided solutions to your calibration needs. Find the position of your lab on the chart then refer to the box below for the applicable products. Your local Fluke Sales Engineer would be glad to assist you in matching your needs with specific products.


National Standards Laboratory
Fluke Standards Laboratory
Your Standards Laboratory
Local Standards Laboratory
Primary (Standards) Labs
Fluke Customer Service Calibration Laboratory
Fluke Production Calibration Laboratory
Your Calibration Laboratory
Independent Calibration Laboratory
Secondary (Calibration) Labs
CALIBRATED PRODUCTS

Primary Laboratory Calibration Equipment

Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Dividers/ Resistance
732A	540B	5220A	—	752A
5440B	5200A	Y5020	—	5450A
5442A	5215A		540B	720A
731B	510A		A40	721A
335A	A55		A40A	750A
335D	5205A			
845AB				
845AR				

Secondary Laboratory Calibration Equipment

Direct Voltage	Alternating Voltage	Direct Current	Alternating Current	Resistance	Automated Calibration	
					Meter	Scope
5440B	5200A	5220A	—	5450A		
5442A	5215A				A123	7410A
5100B	—	—	—	—		
5101B	—	—	—	—	7404B	
343A	5205A				7405A	
515A	—			515A	7405A/AC	
					7411A	—
					7449A	—

Introduction

Calibration is a dynamic discipline which requires sophisticated instrumentation, professional practice of metrology, and continuing improvements in efficiency and capability. Fluke has been a leader in the calibration business for over 30 years, introducing new products to make your task easier, while maintaining a reputation for high accuracy, stability, and product line integrity. Fluke calibrators have been researched and developed to meet your specific requirements for calibration capability.

	Multimeter Calibration	Direct Voltage Calibration	Alternating Voltage Calibration	Direct Current Calibration	Alternating Current Calibration	Resistance Calibration
5440B		●				
5442A		●				
5100B	●	●	●	●	●	●
5101B	●	●	●	●	●	●
5200A			●			
5450A						●
515A	●	●	●			●
335A		●				
335D		●				
343A		●				
7105A		●				

Accuracy and Uncertainty

Most calibration instruments include a specification called "accuracy." This is a statement of the largest allowable error expressed as a percentage of an absolute value. This number is properly called "uncertainty" because it is the allowed deviation from the nominal; it is a small number, where accuracy would be a large number. (Accuracy could be considered 1 - % uncertainty.)

Uncertainty can be a difficult specification to interpret because there are four accepted accuracy statements that can be combined in several different ways:

- Percent of output
- Percent of full scale
- Number of digits
- Number of units (e.g., microvolts)

This specification can be even further obscured through the use of various terms: percent, ppm, digits, microvolts, etc.

Percent and PPM

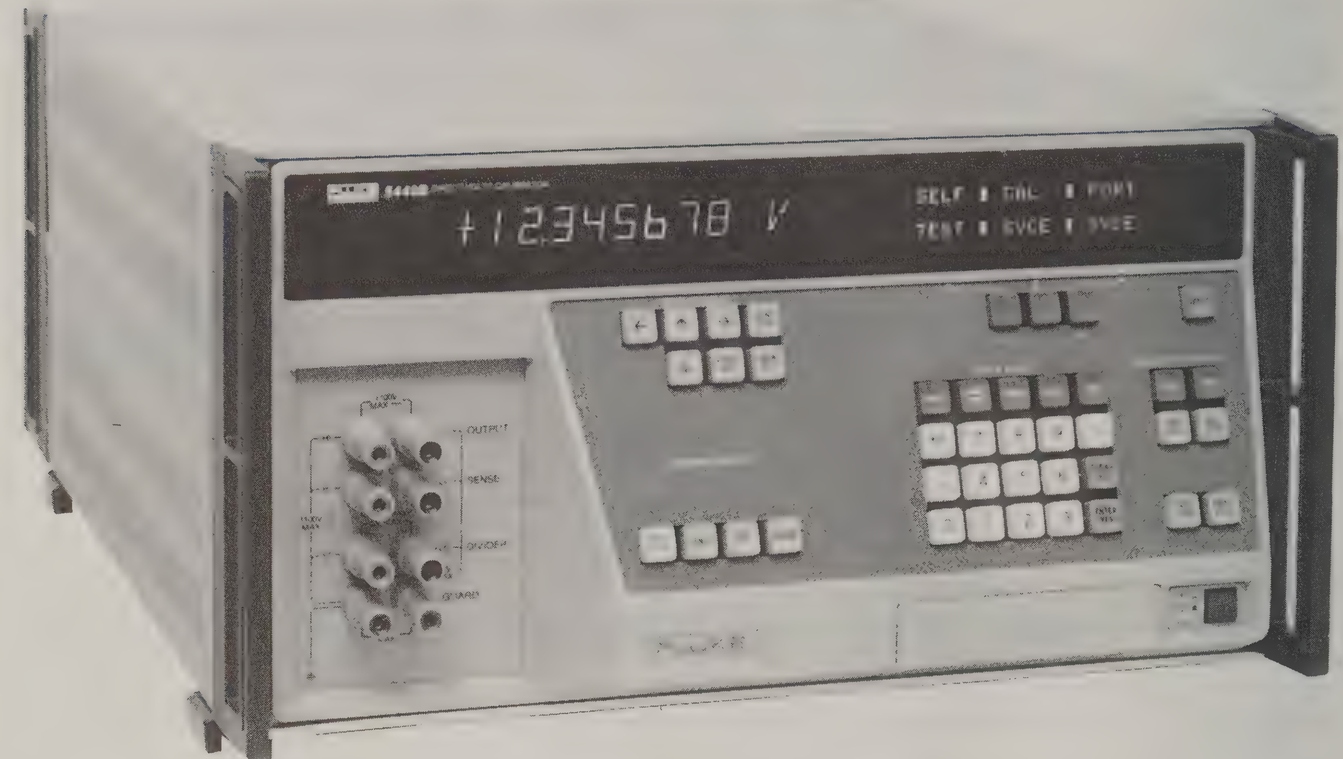
Calibrator and meter uncertainty specifications are usually given as either percent or parts per million (ppm). These are interchangeable concepts. We have chosen to use the term "ppm" for the most part, mainly to make the numbers more easily readable by reducing the number of zeros. This table will give you an idea of how they relate:

0.1% = 1000 ppm
0.01% = 100 ppm
0.001% = 10 ppm
0.0001% = 1 ppm

An easy memory aid to use is 0.01% and 100 ppm. Reverse the order of the numbers in 0.01% and it comes out as 100 ppm.

CALIBRATORS

5440B/5442A



5440B

5440B & 5442A Direct Voltage Calibrators

- Full accuracy over extended temperature range of 10°C
- Completely automatic internal calibration, no mechanical adjustments
- Simplified 5-minute external calibration to traceable standards
- Test procedure memory and Procedure Storage Module for single button test setup (5440B only)
- Completely programmable through the IEEE-488 interface
- RS-232-C interface for printer output of calibration constants and instrument test results
- Bright vacuum-fluorescent displays for high visibility at all angles and lighting variations

The 5440B and 5442A are programmable direct voltage calibrators with an output voltage range of zero to 1100 volts and uncertainty specifications on the 10 volt range of 3 and 4 ppm respectively, referred to national standards.

The 5440B and 5442A are equipped with bright vacuum-fluorescent displays for clear visibility at any viewing angle. Even inexperienced operators find the 5440B and 5442A easy to use because the 40-character, alphanumeric display provided in addition to the numeric output display makes operating instructions and error messages clear and readable in engineering units and English language messages instead of coded numerics. For semi-automated testing, the 5440B allows a complete test sequence of up to 60 steps to be stored in the internal Procedure Storage memory and recorded for later use in the interchangeable, plug-in Procedure Storage Modules. A test sequence is recalled and executed one step at a time with each touch of the NEXT STEP key.

The differences between the 5440B and the 5442A are in the operating features. The 5440B comes equipped with the Procedure Storage Module capability and boost capability for driving the 5205A Precision Power Amplifier and 5220A Transconductance Amplifier in system applications. The rear output terminals found on the 5440B as a standard feature are available for the 5442A as an option. Both instruments have outstanding accuracy specifications and the capability for operating at full rated accuracy over a temperature range of ±5°C from the calibration temperature, making them well-suited for operation in a production environment as well as in a standards lab. Both instruments are completely programmable via the IEEE-488 interface which is included at no extra cost.

The outstanding accuracy specifications for the 5440B and 5442A are easily maintained in any lab by performing the simple, automatic calibration procedures which store the calibration constants in non-volatile EAROM solid-state memory. No hardware adjustments are required. The Fluke 732A Reference Standard combined with the Fluke Direct Volt Maintenance Program and the Fluke 752A Reference Divider, provide the highest accuracy reference standards available for this periodic calibration.

Specifications

Specifications apply to both the 5440B and 5442A unless otherwise noted.

Output Voltage: 0 to 1100V
Output Current: 0 to 25 mA

5440B:
Output Uncertainty Compared to Calibration Standards, ±5°C

Range	Uncertainty Specification: ±(PPM of Output + Microvolts)			
	30 Days	90 Days	180 Days	1 Year
0V to 11V	1.5 + 5 µV	2.0 + 5 µV	2.5 + 5 µV	3.5 + 5 µV
11V to 22V	1.5 + 8 µV	2.0 + 8 µV	2.5 + 8 µV	3.5 + 8 µV
22V to 275V	2.5 + 100 µV	3.5 + 100 µV	4.5 + 100 µV	6.0 + 100 µV
275V to 1100V	2.5 + 400 µV	3.5 + 400 µV	4.5 + 400 µV	6.0 + 400 µV
Divided Output				
0-220 mV	4 + 0.5 µV	5 + 0.5 µV	6.5 + 0.5 µV	10 + 0.5 µV
0.22-2.2V	3 + 1 µV	4.5 + 1.0 µV	6 + 1.0 µV	8 + 1.0 µV

5442A:
Output Uncertainty Compared to Calibration Standards, ±5°C

Range	Uncertainty Specification: ±(PPM of Output + Microvolts)			
	30 Days	90 Days	180 Days	1 Year
0V to 11V	2.5 + 5 µV	3 + 5 µV	4.5 + 5 µV	6.5 + 5 µV
11V to 22V	2.5 + 8 µV	3 + 8 µV	4.5 + 8 µV	6.5 + 8 µV
22V to 275V	3 + 100 µV	3.5 + 100 µV	5 + 100 µV	7 + 100 µV
275V to 1100V	3 + 400 µV	4 + 400 µV	5.5 + 400 µV	8 + 400 µV
Divided Output				
0-220 mV	6 + 0.5 µV	7 + 0.5 µV	9 + 0.5 µV	12 + 0.5 µV
0.22-2.2V	4 + 1 µV	6 + 1.0 µV	8 + 1.0 µV	11 + 1.0 µV

Uncertainty of Calibration Standards Compared to National Standards

Range	Uncertainty of Standards
0V to 11V	1.5 PPM
11V to 22V	1.5 PPM
22V to 275V	1.7 PPM
275V to 1100V	2.0 PPM
0V to 220 mV	4.0 PPM
0.22 to 2.2V	2.0 PPM

Output Uncertainty Compared to National Standards

The output uncertainty compared to national standards for the 5440B and 5442A are defined as the algebraic sum for each range of the output uncertainty compared to calibration standards and the uncertainty of the calibration standards compared to national standards. The specifications for uncertainty of calibration standards listed above are those for the Fluke 732A and Fluke 752A. If other standards are used, the uncertainty of those standards must be substituted.

Output Stability

Specifications apply for initial stabilization of two hours, constant ambient temperature of ±1°C, constant line voltage, constant load, and measurement bandwidth of 0.1 Hz to 1 Hz.

Range	±(PPM of Setting + Floor)		
	10 Minutes	24 Hours	30 Days*
0V to 11V	0.2 + 2 µV	0.3 + 3 µV	0.5 + 3 µV
11V to 22V	0.2 + 3 µV	0.4 + 4 µV	0.5 + 4.5 µV
22V to 275V	0.3 + 40 µV	0.3 + 50 µV	1.0 + 60 µV
275V to 1100V	0.3 + 200 µV	0.3 + 200 µV	1.0 + 300 µV
Divided Output			
0 mV to 220 mV	0.5 + 0.2 µV	0.5 + 0.2 µV	2 + 0.3 µV
0.22V to 2.2V	0.5 + 0.2 µV	0.5 + 0.5 µV	2 + 0.7 µV

**For best results, use internal calibration for periods exceeding one day.*

Absolute and Relative Uncertainty Specifications

Calibration instrument specifications are related to the accuracy of the standards used to calibrate them. For example, the 5440B and 5442A absolute uncertainty specifications account for the 732A dV Reference Standard. The calibrators have a set of uncertainty specifications relative to the 732A, and the uncertainty specifications of the 732A are relative to national standards. The two uncertainties must be added together to determine the "absolute" uncertainty of the 5440B or 5442A, that is, the uncertainty relative to national standards. Relative uncertainty specifications allow you to determine the absolute uncertainty of a calibrator when it is calibrated with other than the manufacturer's specified standards. If you use a different set of standards, you will need to know what contribution those standards (or process) make.

Temperature Coefficient of Output

These specifications apply for ambient temperatures outside the ±5°C range of the uncertainty specifications listed earlier.

Range	±(PPM of Setting) per °C			
	0-10°C	10-30°C	30-40°C	40-50°C
0V to 11V	0.15 ppm	0.1 ppm	0.4 ppm	1.0 ppm
11V to 22V	0.15 ppm	0.1 ppm	0.4 ppm	1.0 ppm
22V to 275V	0.2 ppm	0.2 ppm	0.6 ppm	1.5 ppm
275V to 1100V	0.2 ppm	0.2 ppm	1.0 ppm	1.5 ppm
Divided Output				
0 to 220 mV	0.5 ppm	0.5 ppm	0.5 ppm	1.2 ppm
0.22V to 2.2V	0.5 ppm	0.5 ppm	0.5 ppm	1.2 ppm

Linearity

These specifications apply for the ambient temperature range of 15°C to 30°C within ±5°C of the external calibration temperature.

Range	±(PPM of Output + Microvolts)
0 mV to 220 mV	0.5 ppm + 0.2 µV
0.22V to 2.2V	0.7 ppm + 0.3 µV
0V to 11V	0.5 ppm + 1.5 µV
11V to 22V	0.5 ppm
22V to 275V	0.5 ppm + 40 µV
275V to 1100V	1.0 ppm

Resolution

Range	Resolution	Maximum Setting	Maximum Load or Output Resistance
0V to 11V	1 µV	11.000000V	25 mA
11V to 22V	1 µV	22.000000V	25 mA
22V to 275V	10 µV	275.00000V	25 mA
275V to 1100V	100 µV	1100.0000V	25 mA
Divided Output			
0 to 220 mV	0.01 µV	220.00000 mV	495Ω
0.22V to 2.2V	0.1 µV	2.2000000V	450Ω

Output Noise

Range	Bandwidth	
	0.1 Hz to 10 Hz	10 Hz to 10 kHz
0 mV to 220 mV	0.1 μV	5 μV
0.22V to 2.2V	0.2 μV	15 μV
0V to 11V	1.5 μV	30 μV
11V to 22V	3.0 μV	50 μV
22V to 275V	35 μV	150 μV
275V to 1100V	100 μV	300 μV

Output Settling Time

Time to settle within a given uncertainty band of final value, for a change in programmed output within a given range.

Range	±Parts per Million of Change*		
	3 seconds	5 seconds	10 seconds
0 mV to 220 mV, 0.22V to 2.2V, 0V to 11V, and 11V to 22V	7 ppm	2 ppm	0.5 ppm
22V to 275V 275V to 1100V	—	—	3 ppm

* *Add 0.5 seconds for any change in range up to 22V, 1.0 second for a change from 22V up, and 0.5 seconds for a change from STBY to OPER.*

Line Regulation: Changes less than ±0.1 ppm of range for ±10% change from nominal line voltage
Load Regulation: Less than ±0.1 ppm change of output for change from no-load to full-load or from full-load to no-load for output load impedances greater than 80 ohms
Common Mode Rejection: Greater than 140 dB for frequencies from dc to 400 Hz
Temperature: 0°C to 50°C, operating, except accuracy is degraded above 40°C due to loss of oven regulation; -40°C to +75°C non-operating
Relative Humidity: ≤90% to 30°C except accuracy is degraded above 80%, ≤70% to 40°C, ≤40% to 50°C

Vibration

Frequency	Force	Double Amplitude
5 Hz to 15 Hz	0.7G at 15 Hz	0.06 inches
15 Hz to 25 Hz	1.3G at 25 Hz	0.04 inches
25 Hz to 55 Hz	3G at 55 Hz	0.02 inches

Shock: Eighteen 20G ½-sinewave shocks
Compliance With External Standards: ANSI C39.5 Dec 1980 and IEC 348 Second Edition 1978
EMI/RFI Review Standards: FCC Rules Part 15, Subpart J; European Standard VDE 0871; MIL STD 461B
EMI/RFI Conducted Emissions: FCC Rules Part 15 Class J; European Standard VDE 0871; CISPR.11
Radiated EMI/RFI Emissions: Meets or exceeds all FCC and VDE requirements
Power: 100V, 110V, 115V, 120V ac ±10% or 200V, 220V, 230V, 240V ac ±10%, 50 to 60 Hz, 84W Standby, 145W nominal
Size: 61 cm L x 43 cm W x 24 cm H (24 in x 17 in x 9.4 in)
Weight: 30.2 kg (66.4 lb)
Mounting: Standard 19" EIA relay rack, tapped for attachment of slides; resilient feet provided for bench use
Included
5440B: Procedure Storage Module, IEEE-488 Interface, RS-232-C Printer Interface, Boost Interface, Rear Output
5442A: IEEE-488 Interface, RS-232-C Printer Interface

Models

January 1986 prices

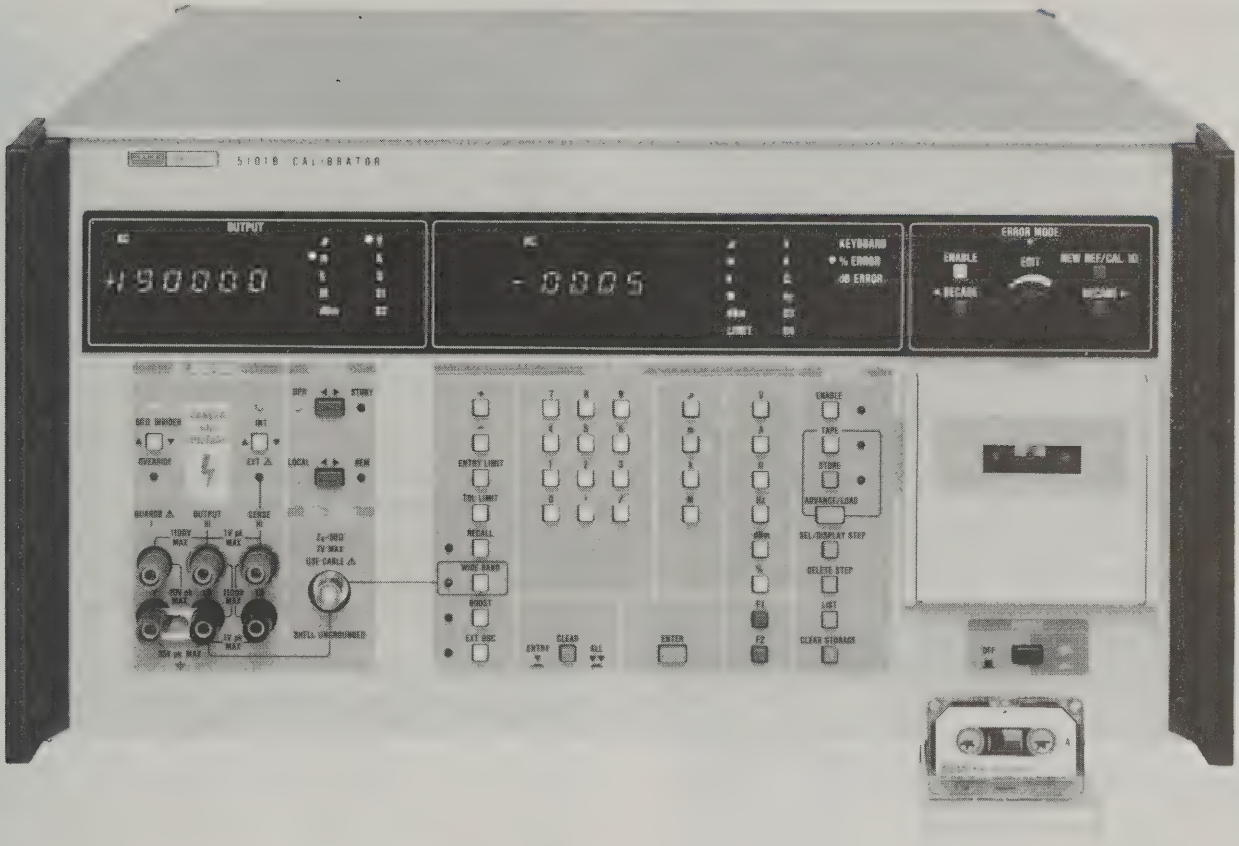
5440B Direct Voltage Calibrator	$12,950
5442A Direct Voltage Calibrator	10,950

Accessories (Also see page 230)

5440A-7001 Spare Procedure Storage Module	220
5440A-7002 Low Thermal EMF Plug-In Cables	325
732A DC Reference Standard	3195
752A Reference Divider	4295
M08-205-600 8¾" Rack Mount Kit	105
M00-280-610 24" Rack Slide Kit (Requires M08-205-600)	110
5442A-01 Rear Output Option	345

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



5101B

5100 Series B Calibrators

- The world standard of multifunction calibrators
- Cost-effective multimeter calibration to 4½-digits
- Five functions: Direct or alternating volts or amps plus ohms
- Cassette tape drive available for storing procedures
- Cluster or workstation capability, 7411A compatible

The 5100 Series B Calibrators offer the convenience of calibrating precision meters that measure direct and alternating voltages and currents and/or resistance. Its microprocessor-based design speeds up repetitive testing — including semi-automated testing using cassette tapes, and automated testing using 7411A software!

5100 Series B Increases Throughput

A large share of the workload of meter calibration laboratories and production lines consists of analog and digital meters with 4½-digit or less resolution. There are hundreds of different meters in this category representing different manufacturers, with no standard format for meter specifications. Even meters from the same manufacturer are often specified differently. This creates a real problem for any cal lab manager.

Until Fluke introduced the 5100 Series, calibration lab and production line managers were forced to write elaborate test procedures to convert the complex specifications into a step-by-step procedure for inexperienced workers. Or they could use expensive, highly-skilled technical people to perform the test without a procedure. These methods sometimes exceeded the initial cost of the instrument by three to five times over a 5-year period.

Operating the 5100 Series B is simple, making it easy to train your operators. And all data is entered via a calculator-type keyboard. No need to convert volts to dBm or dBm to volts, for example. And the 5100 Series B performs the mathematical computations associated with calculating the error of the unit-under-test (UUT) — in % or in dB. It then indicates to the operator whether the UUT passed or failed, according to its specified uncertainty and the magnitude of the error.

The 5100 Series B calibrates meters quickly and efficiently. It is no longer necessary to gather together separate calibration instruments requiring complex interconnection and operation. A single 5100 Series B does the whole job.

5101B Has System Features

The 5101B is designed for the user who needs the automated features of a large computer aided calibration system without the hardware and software costs of a large system.

A typical calibration procedure consists of forty or fifty separate steps. For most benchtop systems, each step must be loaded into the calibrator — an operation that is slow and prone to human error. The 5101B has a built-in cassette tape deck to store calibration procedures and step through them under microprocessor control.

Initially, the operator records the procedure on a cassette and uses a separate cassette for each procedure. Once recorded, the procedure can be repeated in a fraction of the usual time. Preparing the calibration tape and operating the 5101B, requires no special knowledge of computers or computer languages. Using a printer with the 5101B, you can document both the calibration procedure and the test results with a hard-copy record.

5102B Has Rugged Case

The 5102B is the same as a 5100B but includes a rugged combination case with removable sealed end covers. It is for military applications.

CALIBRATORS

5100 Series B

Automated Calibration

Both the 5100B and 5101B can be used in computer-aided calibration applications by adding a Fluke 1722A or 1752A Instrument Controller and 7411A Calibration Software. Configurations available include benchtop clusters and mobile workstations. Preprogrammed calibration procedures are included in the software packages. Consult your local sales office for details.

Extended Power and Current Capabilities

The 5205A Precision Power Amplifier and the 5220A Transconductance Amplifier will operate as an integrated system with either a 5100B, 5101B, or 5102B. The purpose is to extend the voltage and current sourcing capabilities beyond the basic built-in capabilities of the 5100 Series B Calibrators.

Voltage sourcing may be extended from 6 mA maximum to 100 mA maximum at 1100V for direct voltage. And alternating voltage sourcing may be extended from 20V at 50 kHz to 1100V at 50 kHz. Current sourcing may be extended from 2A to 20A.

A Y5000 Interface/Buffer is needed to integrate a 5205A and/or a 5220A with either a 5100B or 5101B. It connects to the rear panels and preserves the advantage of single-point control of calibration, automatic error calculation, entry limit protection, etc., inherent in the 5100 Series B or 5102B plus cassette tape storage of calibration steps in the 5101B.

Specifications

Direct Voltage

Range	Resolution	Maximum Current	Ripple and Noise (10 Hz to 3 kHz, NL to FL, RMS)
20 mV	0.1 µV	Limited by 50Ω output resistance or 25 mA using 50Ω override	0.01% of setting +25 µV**
200 mV	1 µV		
2V	10 µV		
20V	100 µV	25 mA/1000 pF	0.02% of setting +50 µV
200V	1 mV	10 mA/400 pF*	0.05% of setting (open to 20 kΩ) 0.1% of setting (20 kΩ to full load)
1100V	10 mV	6 mA/400 pF*	0.05% of setting

**100 mA/1500 pF with 5205A, Y5000 and Y5001*
***Double both terms for divider override mode*

Uncertainty: ±(0.005% of setting +0.001% of range +5 µV) for all ranges, for 6 months, 20°C to 30°C ambient, non-override; ±(0.005% of setting + 0.2 mV) for divider override mode
Temperature Coefficient: Above 30°C and below 20°C, ±(5 ppm of setting +1 ppm of range +1 µV)/°C to 200V, ±(5 ppm of setting +2 ppm of range)/°C, 200V to 1100V
Short Term Stability: (For 10 minutes from 0°C to 50°C) ±(10 ppm of setting +2 ppm of range +5 µV) to 500V; ±25 ppm of setting, 500V to 1100V
Load Regulation: (External Sense) ±10 ppm from 2V to 1100V, no-load to full-load. (Internal Sense) same as external except full-load is 400Ω

Alternating Voltage

Range*	Resolution	Maximum Load	Total Harmonic Distortion and Noise
20 mV	0.1 µV	Limited by 50Ω output resistance	Bandwidth of 10 Hz to 200 kHz, Distortion, line interference + noise including random spikes **20V and Higher** 50 Hz to 10 kHz: 0.08% of output rms **Below 20V** 50 Hz to 10 kHz: (0.05% of output + 10 µV) rms 10 kHz to 50 kHz: (0.08% of output + 20 µV) rms
200 mV	1 µV		
2V	10 µV	2 kΩ/ 1000 pF	
20V	100 µV	25 mA/ 1000 pF	
200V	1 mV	10 mA/ 400 pF	
1100V	10 mV	6 mA/ 400 pF **	

**Can be set in dBm where 0 dBm = 1 mW in 600Ω = 0.7746V*
***200 mA/1500 pF with 5205A, Y5000 and Y5001*

Uncertainty: ±(0.05% of setting +0.005% of range +50 µV) from 50 Hz to 10 kHz and ±(0.08% of setting +0.008% of range +50 µV) from 10 kHz to 50 kHz for 6 months, 20°C to 30°C ambient
Frequencies Available (Hz): 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, and 900 for all voltage ranges.

Frequencies Available (kHz):

Voltage Range	1	2	3	4	5	6	7	8	9	10	20	30	40	50
110V to 1100V	●	△	△	△	△	△	△	△	△	△	△	△	△	△
20V to 110V	●	●	●	●	●	●	●	●	●	●	●	△	△	△
1 mV to 20V	●	●	●	●	●	●	●	●	●	●	●	●	●	●

△ With 5205A, Y5000, and Y5001

Frequency Uncertainty: ±3%
Temperature Coefficient: Above 30°C and below 20°C ±(20 ppm of setting +2 ppm of range)/°C for amplitude, ±0.1%/°C for frequency
Short Term Stability: ±(0.01% of range +10 µV) for 10 minutes from 0°C to 50°C
Load Regulation: External Sense, ±200 ppm from 0.2V to 1100V, no-load to full-load; Internal Sense, same as external except regulation for voltages <0.2V is expressed as an output impedance of 50Ω

Direct Current

Range	Resolution	Compliance Voltage	Ripple and Noise
200 µA	1 nA	0 to 10V	(0.05% of output +0.01 µA) rms Measured with 10 Hz to 10 kHz bandwidth including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 µA		
2A*	10 µA	0 to 2.1V	

**20A with 5220A, Y5000, and Y5002*

Uncertainty: ±0.015% of setting +0.002% of range +0.01 µA) for compliance voltage up to 1V. Add 0.002% of setting per volt above 1V rms. Applies for 6 months and 20°C to 30°C ambient
Temperature Coefficient: Above 30°C and below 20°C ±(10 ppm of setting +2 ppm of range)/°C
Short Term Stability: ±(50 ppm of setting +5 ppm of range +0.002 µA) for 10 minutes from 0°C to 50°C
Load Regulation: ±20 ppm/volt for change in output voltage from 1 volt to maximum compliance voltage

Alternating Current

Range	Resolution	Compliance Voltage	Total Harmonic Distortion and Noise
200 µA	1 nA	0 to 7V rms	(0.05% of output +2 µA) rms Distortion, line interference + noise, including random spikes
2 mA	10 nA		
20 mA	100 nA		
200 mA	1 µA		
2A*	10 µA	0 to 1.4V rms	

**20A with 5220A, Y5000, and Y5002*

Uncertainty: ±(0.05% of setting +0.005% of range +0.02 µA) for compliance voltage up to 1V rms (50 Hz to 1 kHz). Add 0.005% of setting per volt above 1V rms. Applies for 6 months in 20°C to 30°C ambient
Temperature Coefficient: Above 30°C and below 20°C ±(25 ppm of setting +10 ppm of range +0.2 nA)/°C for amplitude, +0.1%/°C for frequency
Short Term Stability: ±(0.014% of setting +0.002% of range +0.4 µA) for 10 minutes from 0°C to 50°C
Load Regulation: ±(50 ppm +20 nA)/volt for change in output voltage from 1 volt to maximum compliance voltage

Resistance

Range: 1Ω to 10 MΩ in decade steps
Uncertainty: ±0.003%, except ±0.015% (1Ω), ±0.010% (10Ω and 1 MΩ), and ±0.030% (10 MΩ) assumes 4 terminal below 100 kΩ. 6 mo 20°-30°C
Power Dissipation: 1W maximum except 100 mW max (1 MΩ) and 10 mW max (10 MΩ)
Temperature Coefficient: Above 30°C and below 20°C, ±5 ppm/°C except ±10 ppm/°C (1Ω and 10Ω), ±10 ppm/°C up to 40°C (10 MΩ), and ±50 ppm/°C above 40°C (10 MΩ)

Extended Specifications

Direct Voltage (with 5205A)

Range: ±100V to ±1100V, with 10 mV resolution
Maximum Load: 100 mA; 1500 pF
Uncertainty: ±(0.07% of setting +20 mV), for 6 months, 20°C to 30°C ambient
Line-Related Noise: ≤50 mV rms
Random Noise: ≤100 mV rms, 1 MHz bandwidth

Alternating Voltage (with 5205A)

Voltage Range: 100V to 1100V rms, with 10 mV resolution
Maximum Load: 200 mA, decreasing linearly to 140 mA from 100 Hz to 50 Hz; 1500 pF
Voltage Uncertainty: ±(0.08% of setting +0.1V) for 50 Hz to 10 kHz; ±(0.12% of setting +0.15V) for 10 kHz to 50 kHz, for 6 months, 20°C to 30°C ambient
Frequency Range: Discrete selections from 50 Hz to 50 kHz with 1 MSD resolution
Frequency Uncertainty: ±3%
Harmonic Distortion and Noise: 0.1% of setting from 50 Hz to 20 kHz, 0.2% of setting from 20 kHz to 50 kHz, for bandwidth of 10 Hz to 1 MHz

Direct Current (with 5220A)

Range: ±1A to ±19.9999A, with 100 µA resolution
Compliance Voltage: 0 to 4V
Uncertainty: ±(0.025% of setting +1 mA), for 6 months, 20°C to 30°C ambient
Ripple and Noise: 0.05% of setting +1 mA rms, 10 Hz to 3 kHz bandwidth

Alternating Current (With 5220A)

Current Range: 1A to 19.9999A rms, with 100 µA resolution
Compliance Voltage: 0 to 3V rms
Current Uncertainty: ±(0.07% of setting +1 mA) rms from 50 Hz to 1 kHz, ±(0.07% of setting +1 mA) x frequency (in Kilohertz) from 1 kHz to 5 kHz, for 6 months, 20°C to 30°C ambient
Frequency Range: Discrete selections from 50 Hz to 5 kHz with 1 MSD resolution
Frequency Uncertainty: ±3%
Harmonic Distortion and Noise: ±(0.07% of setting +1 mA) rms, for bandwidth of 10 Hz to 300 kHz

Option Specifications

Wideband aV Option (-03)

Option -03 is a high accuracy, low noise, extremely flat alternating voltage source which increases the frequency coverage of the 5100 Series B from its standard of 50 Hz to 50 kHz to 10 Hz to 10 MHz. This option enables the 5100 Series B to calibrate wideband meters. A dedicated front panel BNC connector provides ac output from 300 µV (-57.5 dBm) to 3.1623V (+23 dBm) into 50Ω impedance. The output is programmable from the front panel or I/O interface in volts or in dBm (where 0 dBm equals 1 mW into 50Ω). Using a simple formula for calculation of a correction factor and the NEW REF feature, the wideband output can be directly programmed for dBm referenced to other impedances.

With the EDIT control the error of wideband meters can be calculated in % or in dB. With the EDIT control and NEW REF, you may test the frequency response of meters. This method provides a direct reading in percent or dB, ideal for making Bode plots.

Range: 10Hz to 10 MHz

Amplitude Uncertainty, at 1 kHz, Terminated in 50Ω*

Voltage Range	Approx dBm Range	±(% of Setting + % of Range)
1V to 3.1623V	+13 to +23	0.25 + 0.25
0.31624V to 0.99999V	+3 to +13	0.5 + 0.25
0.1V to 0.31623V	-7 to +3	0.75 + 0.25
31.624 mV to 99.999 mV	-17 to -7	1.0 + 0.25
10 mV to 31.623 mV	-27 to -17	1.25 + 0.25
3.1624 mV to 9.9999 mV	-37 to -27	1.5 + 0.25
1 mV to 3.1623 mV	-47 to -37	1.75 + 0.25
300 µV to 0.99999 mV	-57.5 to -47	2.0 + 0.25

**For 6 months, 20°C to 30°C ambient*

Amplitude Flatness*
10 Hz to 30 Hz: ±0.3%
30 Hz to 1 MHz: ±0.25%
1 MHz to 5 MHz: ±0.25% above 1 mV, ±0.6% ≤1 mV
5 MHz to 10 MHz: ±0.6%
**Using 1 foot of RG 58U cable terminated in 50Ω*

Temperature Coefficient: Above 30°C and below 20°C ±(0.1 times basic accuracy)/°C for amplitude. ±0.25%/°C for frequency
Harmonics: -40 dB or lower relative to fundamental for each frequency except -32 dB above 5 MHz
Spurious Outputs: -50 dB or lower relative to fundamental for each frequency
Frequency Resolution: 1 MSD
Frequency Uncertainty: ±3%

IEEE-488 Interface Option (-05)

This interface allows the 5100 Series to be used in a system compatible with IEEE Std 488-1978. System control is via the Fluke 1722A or 1752A Instrument Controller or any host computer. Address coding is done using logic switches accessible on the rear panel. Data is transmitted bi-directionally in ASCII coded format. The following subsets are supported: SH1, AH1, T6, L4, SR1, RL1, DC1, and E2.

Bit Serial Interface Option (-06)

Provides compatibility with EIA Standard RS-232-C or 20 mA current loops. Thirteen baud rates are available from 50 to 9600 and either one or two stop-bits can be set up. Selection is made via rear panel logic switches.

CALIBRATORS

5100 Series B

General Specifications

Shock and Vibration: Meets requirements of MIL-T-28800 for Class 5, size and equipment

Temperature

5100B and 5102B: 0°C to 50°C operating; -20°C to +65°C non-operating

5101B: (With tape cassette) +10°C to +40°C operating; +4°C to +50°C, non-operating. Without cassette: same as 5100B

Relative Humidity: ≤85% to 35°C, ≤70% to 40°C, ≤50% to 50°C

Power: 100, 110, 115, 120, 200, 220, 230, or 240 V ac, switch-selectable ±10%, 50 Hz to 60 Hz. 200VA (5100B) or 220VA (5101B) with all options

Size: 22.2 cm H x 60.3 cm W x 43.2 cm L (8.75 in H x 17 in W x 23.75 in L)

Weight

5100B: 30.4 kg (67 lb) basic, 32.7 kg (72 lb) with all options

5101B: 32.7 kg (72 lb) basic, 34.9 kg (77 lb) with all options

5102B: 35.8 kg (79 lb) basic, 38.1 kg (84 lb) with all options

Included: Manual, power cord, Serialized and Data Calibration Certificate. Also one cassette tape with 5101B

Models

January 1986 prices

5100B	Calibrator	$10,950
5101B	Calibrator, with tape deck	13,650
5102B	5100B in portable case (military)	13,950
5205A*	Power Amplifier	8950
5220A*	Transconductance Amplifier	4795

**Y5001 or Y5002 cable and Y5000 interface required when used with 5100 Series B Calibrator*

Options (for 5100B, 5101B, 5102B)

5100A-03	Wideband AC Voltage	2750
5100A-05	IEEE-488 Interface	610
5100A-06	EIA RS-232-C Interface	610

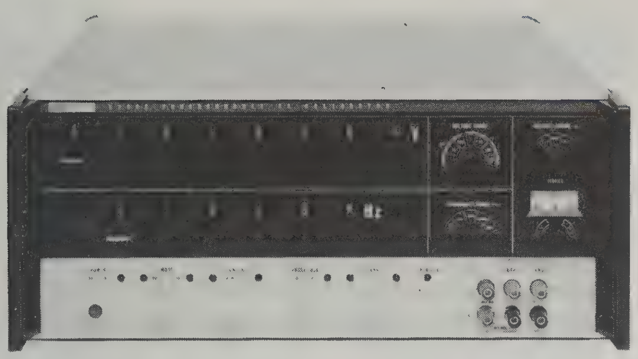
Accessories (Also see page 230)

5100A-7003K	Fiberglass Case, 5100B/5101B	610
5100A-7005K	Extender Kit	445
M08-205-600	8¾" Rack Adapter	105
M00-280-610	*24" Rack Slides	110
Y5000	Interface Buffer	555
Y5001	Cable for 5205A and Y5000	250
Y5002	Cable for 5220A and Y5000	225
Y8021	1m Cable for IEEE-488 bus	85
Y8022	2m Cable for IEEE-488 bus	95
Y8023	4m Cable for IEEE-488 bus	105
Y8004	1.5m Cable for RS-232	105
Y8007	10-pack of cassettes for 5101B	150

**Requires M08-205-600*

After Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



5200A

5200A Precision Alternating Voltage Calibrator

- 120 ppm point uncertainty available
- Seven voltage ranges from 1 mV to 1000V
- 6½-digit resolution (1,199,999 counts)
- Output frequencies from 10 Hz to 1 MHz
- Automated characterized operation available
- IEEE-488 system interface available
- Phase-lock input
- Completely guarded
- Short and overload protected

A Proven Performer

The Model 5200A Alternating Voltage Calibrator is a precision high-performance alternating voltage source with proven reliability and exceptional stability and accuracy over a broad frequency range. It is specified over a wide 0°C to 50°C operating range for use in both laboratory and manufacturing environments. Amplitude is controlled in six ranges from 1 mV to 100V. Resolution to 1,199,999 counts yields 20% overrange capability with 1 nanovolt steps on the 1 mV range, up to 0.1 mV steps on the 100V range. Outputs from 100 μV rms to 120V rms are provided, with up to 50 mA load current capability.

An additional 1000V range is included for front panel or remote interface control of a 5205A or 5215A Precision Power Amplifiers.

Amplitude error measurement for voltmeter calibration is provided in two ranges, ±3% and ±0.3%. Error measurements can be resolved to 10 ppm.

Five frequency ranges are provided from 100 Hz to 1 MHz, with 119,999 count resolution for 20% overrange capability with 0.01 Hz steps on the 100 Hz range, up to 100 Hz steps on the 1 MHz range.

The oscillator of the 5200A may be phase locked to an external source to produce synchronous signals of precision amplitude and stability. Signal phase is locked within ±1° of phase angle, ±0.05°/kHz, over a ±2% band around the center frequency. This capability is essential for 60 Hz calibration.

A 3V pulse signal is provided for monitoring frequency with an external counter.

A quadrature output signal is provided which leads the fundamental signal phase by 90°. Amplitude varies from 1V to 10V rms, proportional to the fundamental signal output level on any range. This signal is useful for wattmeter calibration, and for research and development tasks that use the 5200A as a precision source.

External sensing may be selected, bringing rated accuracy to the load point bypassing losses in output leads.

Outputs are protected from overload by current limiting. Overload response time is typically 2 microseconds. When an overload is removed output recovers automatically to its previous level.

The 5200A is a fully guarded calibrator. This allows floating operation, and eliminates system ground loop problems. This is especially useful for calibrating non-guarded equipment.

Remote Programming

The 5200A is remotely programmable in all functions except Power, Remote/Local, and Vernier Voltage Error. For any programmed amplitude, the output settles to its specified uncertainty within 0.5 seconds for frequencies above 100 Hz, and within 4 seconds for frequencies below 100 Hz. Program status flags are provided to indicate settling time and current limit conditions to the controller.

Either the 5200A-01 Parallel Remote Control Interface or the 5200A-05 IEEE-488 System Interface may be installed in the 5200A, for complete remote control of both the 5200A and a 5205A or 5215A Power Amplifier.

The 5200A-01 Parallel Remote Control Interface provides excellent isolation between external system logic and internal calibrator circuitry. This isolation is typically $10^9\Omega$ in parallel with 30 pf capacitance. This effectively attenuates external logic and ground noise better than 100:1 at 10 MHz.

Command data is segmented into 4-bit groups that can be programmed separately or simultaneously. Command data is stored both inside and outside the guard.

5200A-01 programming levels are compatible with TTL logic, and with contact closure:

Standard levels:
  Logic 1 or true = 0 to +0.4 dV
  Logic 0 or false = +2.8V to +5.0 dV

(For inverted logic levels, also order option 5200A-03.)

The 5200A-01 includes both standard and blank address matrix cards, and a mating connector.

The 5200A-05 IEEE-488 System Interface incorporates subsets SH1, AH1, T6, TEO, L4, LEO, SR1, RLO, PPO, DC2, and DTO of IEEE Standard 488-1980. It allows complete remote programming of all functions except Power, Remote/Local, and Vernier Voltage Error. In addition, the 5200A-05 may be addressed for a 2-byte status response or serial polled for a 1-byte response. Status information includes Remote/Local, Standby/Operate, limits, settling time, and out-of-range instruction.

Automated Characterized Operation

The established excellent stability and performance history of the 5200A Alternating Voltage Calibrator offer an opportunity for further reducing calibration uncertainty while greatly simplifying use by unskilled operators.

Characterization is a process of measuring a particular calibrator's uncertainties at selected points using traceable transfer standards and recording those uncertainties in a table. When the selected points are used, the portion of these uncertainties not due to the transfer standards or to the characterization process can then be added to (or subtracted from) the calibrator setting. In practice, this significantly reduces calibrator uncertainty.

If you know the characteristics of the calibrator design, you can then use mathematical interpolation methods for points other than those selected for characterization. While this will yield a significant improvement in uncertainty specifications, it can be complex and time consuming when done manually.

Option 5200A-800 is a software package that uses a Fluke 1722A or 1720A Instrument Controller to operate a 5200A Alternating Voltage Calibrator and a 5205A or 5215A Precision Power Amplifier. This software makes use of a stored characterization table and automatically interpolates for voltages and frequencies selected between characterization points.

The 5200A-800 controls all calibrator functions in a simplified manner with the touch-sensitive display of the 1722A or 1720A.

5200A

Calibration

The 5200A is originally calibrated at the factory by instrumentation traceable to the U.S. National Bureau of Standards. Periodic traceable recalibration service is available through Fluke Technical Service Centers and Sales Representatives worldwide.

Fluke also offers 5200A characterization service as well as 540B characterization for customers doing their own 5200A characterization. The table of correction factors is supplied in written form, and on a disk compatible with the 5200A-800.

Specifications

Amplitude Uncertainty

Basic instrument uncertainty is specified for 90 days. Characterized uncertainty requires optional 5200A-900 characterization, and is specified for 180 days. Both specifications are valid when operating in an ambient temperature between 18°C and 28°C after a 1-hour warmup.

Basic Instrument Absolute Uncertainty[1]			Characterized Uncertainty[2]		
Voltage Ranges	Frequency Hz	±(ppm setting + μV)	Frequency Hz	±(ppm setting + μV)	
				Relative	Absolute
1 mV[3] 10 mV	10-30	1000+10			
	30-20K	200+10			
	20K-100K	500+20			
	100K-1M	3300+30			
100 mV	10-30	1000+10	50-100	130+10	150+10
	30-20K	200+10	100-20K	125+10	145+10
	20K-100K	500+20	20K-50K	180+20	250+20
	100K-1M	3300+30	50K-100K	200+20	470+20
		±(ppm setting + ppm range)		±(ppm setting + ppm range)	
1V 10V 100V	10-30	1000+50	50-100	130+20	150+20
	30-20K	200+20	100-20K	125+15	145+15
	20K-100K	500+50	20K-50K	180+20	250+20
	100K-1M	3300+300	50K-100K	300+30	470+30
1000V[4]	10-30	1200+50	50-100	190+20	210+20
	30-20k	400+20	100-10k	180+20	180+20
	20k-50k	800+50	10k-20k	200+20	200+20
	50k-100k	1000+100	20k-50k	310+30	310+30

Notes:

1. *Traceable to U.S. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques, 90 days*
2. *180 days. Requires 5200A-900*
3. *On 1 mV range, specification applies for measuring instruments with less than 2 MHz bandwidth.*
4. *With 5205A or 5215A Power Amplifier*

Characterized-Point Absolute Uncertainty, ±ppm*									
	Frequency, Hz								
Voltage	50	100	200	1k	2k	10k	20k	50k	100k
0.5	125	125	—	125	—	125	—	210	450
1	120	120	120	120	120	120	120	200	450
3	130	130	—	130	130	130	—	220	450
10	120	120	120	120	120	120	120	200	450
30	130	130	—	130	—	130	—	220	450
100	120	120	120	120	120	120	120	200	450
300	190	190	—	190	—	190	—	630	—
1000**	180	180	180	180	180	180	200	610	—

** 180 days. Requires 5200A-900. Traceable to U.S. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques*

*** With 5205A or 5215A Power Amplifier.*

Voltage Resolution

Range	Voltage Settings	Resolution
1 mV	0.100000 mV to 1.199999 mV	1 nV
10 mV	1.00000 mV to 11.99999 mV	10 nV
100 mV	10.0000 mV to 119.9999 mV	100 nV
1V	0.100000V to 1.199999V	1 μV
10V	1.00000V to 11.99999V	10 μV
100V	10.0000V to 119.9999V	100 μV
1000*	100.000V to 1199.999V	1 mV

**With 5205A or 5215A Power Amplifier*

Stability

Voltage Ranges	Frequency Hz	Stability[1] (ppm setting + ppm range)[2]	
		10 Minutes	180 Days
1 mV 10 mV	10 - 30	70 + 40	300 + 60
	30 - 20k	70 + 3[3]	100 + 30
	20k - 100k	70 + 3	130 + 40
100 mV	10 - 30	70 + 40	300 + 60
	30 - 1k	70 + 3[3]	70 + 40
	1k - 20k	70 + 3	100 + 30
	20k - 50k	70 + 3	120 + 50
	50k - 100k	70 + 3	100 + 130
1V 10V 100V	10 - 30	70 + 40	200 + 20
	30 - 20k	35 + 5[3]	45 + 5
	20k - 50k	55 + 5	65 + 5
	50k - 100k	70 + 3	220 + 20
1000V[4]	10 - 100	0 + 50	200 + 0
	100 - 20k	70 + 5	200 + 0
	20k - 100k	70 + 5	400 + 0

Notes:

1. *Constant line, load, and temperature*
2. *Total peak to peak random change in rms value*
3. *For frequencies below 50 Hz, floor is 40 ppm of range*
4. *With 5205A or 5215A Power Amplifier*

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C; for the 1000V range add ±(0.03 x uncertainty) per °C

Maximum Load: 1 mV, 10 mV, 100 mV ranges: minimum 6000Ω load impedance; 1V*, 10V, 100V ranges: maximum load current 50 mA; 1000V range: maximum load current 200 mA

**Minimum load impedance 50Ω above 0.1 MHz*

Voltage Error Control: Switch selectable OFF, or two ranges: 0 to ±0.3% with 10 ppm resolution; 0 to ±3% with 100 ppm resolution

Settling Time

Frequency Hz	Settling Time,* Seconds
10 - 30	4 to 15
30 - 100	4
100 - 400	2
400 - 1M	1**

**To within 100 ppm of change*

***Typically less than 0.5 second, except frequency range changes*

External Sense: Switch selectable, internal or external, available on 1V, 10V, and 100V ranges.* Output rises to less than 2.0V rms above selected level when sense lines are disconnected in external sense mode

* *Output impedance on 1 mV, 10 mV, and 100 mV ranges is less than 1.5Ω in series with 1.5 µH*

Frequency Performance*

Range	Frequency Settings	Resolution** Hz	Uncertainty ±(% of input + % of Range)
100 Hz	10.00 Hz to 119.99 Hz	0.01	1.0 + 0.1
1 kHz	.1000 kHz to 1.1999 kHz	0.1	
10 kHz	1.000 kHz to 11.999 kHz	1	
100 kHz	10.00 kHz to 119.99 kHz	10	
1 MHz	.1000 MHz to 1.999 MHz	100	3.0 + 0.3

**90 days, 18°C to 28°C, after 1-hour warm-up*

***100 ppm of range*

Total Harmonic Distortion and Line-Related Noise*

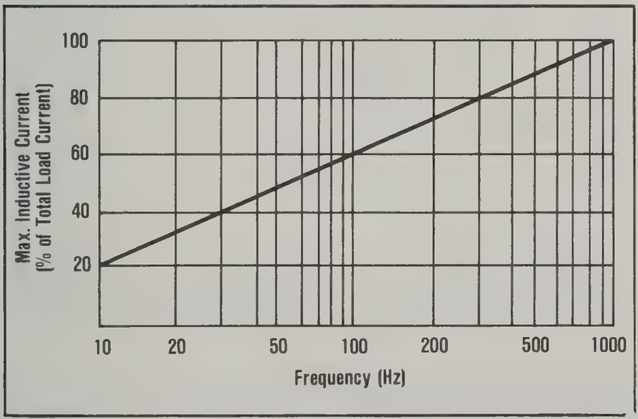
Frequency Hz	±(% of setting + µV rms)
10 - 100k**	0.04% + 10
100k - 500k	0.3% + 30
500k - 1M	1.0% + 30

**Bandwidth 10 Hz to 10 MHz, and less than 15 mA output current except 1000V range. See 5205A or 5215A specifications*

***1V range is ±0.08% from 10 Hz to 15 Hz*

Maximum Capacitive Load: 1000 pF on 1 mV-100V ranges, 1500 pF on 1000V range

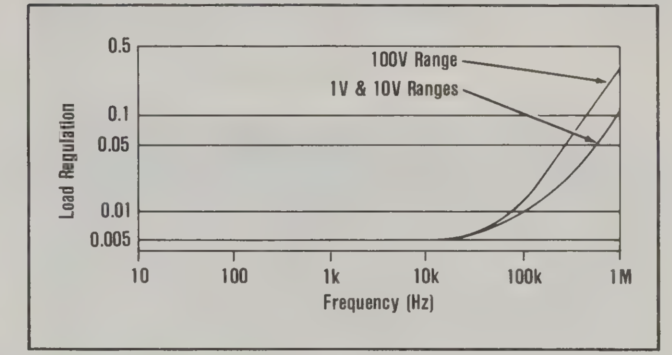
Maximum Inductive Load Current: (Except 1000V range)



Phase Lock Input: 1V to 10V rms, useable down to 100 mV rms
Phase Lock Uncertainty: ±3° below 30 Hz, and ±(1° + 0.05° per kHz) over a ±2% band around center frequency

Quadrature Output:
Amplitude: 1V to 10V rms, ±10%, proportional to selected output voltage
Phase: 10 Hz-40 Hz, 90° ±3°; 40 Hz to 1.2 MHz, 90° ±(1° + 0.03° per kHz)
Minimum Load: 3 kΩ impedance

Current Limit: Typical transition time, 2 µs. Recovery within specified settling time
Volt-Hertz Product: Output voltage x frequency ≤10^7. Full 120V rms output is maintained up to 83.33 kHz. Maximum output voltage at 1.2 MHz is 8.33V rms
Load Regulation: 50 ppm of range, no load to full load, up to 10 kHz



General Specifications

Maximum Isolation Voltages: (dc or peak ac) 500V, GUARD to chassis; 100V, LO to GUARD
Temperature: 0°C to +50°C operating, -40°C to +75°C storage
Input Power: Switch selectable, 100V, 115V, 200V, 230 V, 100W
Size: 17.8 cm H x 43.2 cm W x 57.2 cm D (7 in x 17 in x 22.5 in)
Weight: 24.1 kg (53 lb)
Includes: Instruction manual, mating connectors

Models

January 1986 prices

5200A Precision Alternating Voltage Calibrator	$9950
5215A Precision Power Amplifier	8290
5200A/5215A Precision Alternating Voltage Calibration System	16,945
1722A Instrument Controller	7450

Options

5200A-01* Parallel Remote Control Interface	1225
5200A-03 Logic Level Inversion (for 5200A-01)	205
5200A-05** IEEE-488 System Bus Interface	1850
5200A-800*** Automated Characterized Operation Software	495
5200A-900 Characterization of New-Purchase 5200A and 5215A	685
5200A-902 Characterization of New-Purchase 5200A	620

**Cannot be used with 5200A-05*

***Cannot be used with 5200A-01*

****Requires 1722A or 1720A, and 5200A-900 or 5200-902*

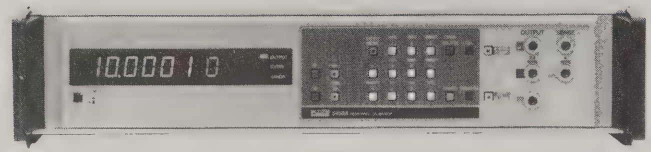
Accessories (Also see page 230)

M07-205-600 Rack Mount Kit for 5200A	105
M10-205-600 Rack Mount Kit for 5215A	105
M00-280-610 24" Rack Slides for rack adapter	110
Y1790 Rack Mount Kit with 24" Slides for 1722A	175
5200A-7015K Extender Board Kit	250

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

5450A



5450A

5450A Resistance Calibrator

- 17 standard resistors in one enclosure
- Decade values from 1.0Ω to 100 MΩ
- 1.9 multiples from 1.9Ω to 19 MΩ
- True passive resistors for low noise and offset
- Midband accuracy of 8 ppm over 18°C to 28°C
- 4-wire or 2-wire operation
- Easy data entry for test lead compensation
- Automatic meter error calculation
- IEEE-488 programmable

The 5450A Resistance Calibrator is designed to verify the resistance-measuring accuracy of precision multimeters, either manually or as part of an automated calibration process. It complements the 5440A Direct Voltage Calibrator.

The 5450A provides cardinal point resistance values in decade steps from 1Ω through 100 MΩ and decade steps from 1.9Ω through 19 MΩ. Because full range readings of most digital multimeters start with the digits 19, the accuracy of readings near the full range may be checked using the 19-series resistors.

Each resistor differs from its nominal value by no more than 0.1%. But the precise value of each is known with a much higher degree of certainty. The known value of each is stored in EAROM and used for calibration purposes. Each value displayed has 1 ppm resolution.

Four-wire connections eliminate the effects of lead resistance or, for 2-wire operation, you may measure and store the lead resistance value and automatically subtract it from the value of each resistor. Connections to the instrument being calibrated may be made to the front panel terminals or to special rear panel binding posts that contribute very low thermal offset voltage errors.

Calibrating the 5450A consists of storing the right values of each resistor in the EAROM. Recalibration can be accomplished without removing the instrument covers, and may even be done remotely over the IEEE-488 bus. A rear panel switch insures integrity of calibration.

The 5450A displays the precise value of each selected resistor and can show the error of the instrument being calibrated — either in percent or in parts per million. All functions that can be controlled from the front panel may be controlled remotely via an IEEE-488 bus. No options are required to make the 5450A compatible with the bus; interface circuits are built in.

Specifications

The following specifications apply when the 5450A is calibrated using a 10 kΩ standard resistor, the absolute value of which is known within ±2 ppm or better and using the ratio calibration method for calibrating resistor values from 10Ω through 100 MΩ. The 1.0Ω and 1.9Ω value must be calibrated by comparison to a 1Ω standard whose absolute value is known within ±5 ppm.

Accuracy, For Rated Current, 4-Wire Connections

Nominal Resistance	Absolute Uncertainty (±ppm unless indicated)				Normal Current Ranges	
	23°C ±1°C, ≤70% RH		23°C ±5°C, ≤70% RH			
	24 Hours	90 Days	90 Days	1 Year	Lower	Upper
Short	.1 mΩ	.1 mΩ	.1 mΩ	.1 mΩ	10 mA	500 mA
1Ω	50	62	75	110	10 mA	100 mA
1.9Ω	40	52	65	100	10 mA	75 mA
10Ω	18	20.5	25	33	10 mA	25 mA
19Ω	16	18.5	23	31	10 mA	25 mA
100Ω	7.5	9	11	16	10 mA	15 mA
190Ω	7	8.5	10.5	15.5	10 mA	15 mA
1 kΩ	5.5	7	8.5	13.5	700 μA	2.5 mA
1.9 kΩ	5	6.5	8	13	500 μA	2.5 mA
10 kΩ	5	6.5	8	13	50 μA	1 mA
19 kΩ	4.5	6	7.5	12.5	50 μA	1 mA
100 kΩ	6	7.5	9	14	5 μA	250 μA
190 kΩ	5.5	7	8.5	13.5	5 μA	250 μA
1 MΩ	7.5	10	11.5	19	5 μA	50 μA
1.9 MΩ	7.7	10	11.5	19	5 μA	25 μA
10 MΩ	16	24	26	50	.5 μA	5 μA
19 MΩ	20	28	30	56	.25 μA	2.5 μA
100 MΩ	65	90	120	200	.05 μA	.5 μA

**Relative to National Standards such as U.S. Bureau of Standards*

General Specifications

Temperature: 0°C to 50°C, operating
Relative Humidity: ≤70% for rated accuracy
Power: 100, 120, 220, or 240 aV ±10%, 50 to 60 Hz ±5%, ≤50W
Size: 8.9 cm H x 43.2 cm W x 55.4 cm L (3.5 in x 17 in x 21.8 in)
Weight: 9.3 kg (20.4 lb)
Included: Instruction manual, line cord

Model

January 1986 prices

5450A Resistance Calibrator	$3995

Option

5450A-600 Additional Manual	on req.

Accessories (Also see page 230)

Y8021 1m Cable for IEEE-488 bus	85
Y8022 2m Cable for IEEE-488 bus	95
Y8023 4m Cable for IEEE-488 bus	105
M00-260-610 18″ Rack Slides	105
M00-280-610 24″ Rack Slides	110
Y8599 3½″ Rack Adapter without Slides	65
Y8598 3½″ Rack Adapter with 22″ Slides	100

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

515A

515A Portable Calibrator

- Precision, portable, 4½-digit calibration and 5½-digit verification where you need it
- Battery powered when disconnected from line power
- Lightweight and small size

The Model 515A Portable Calibrator is a precision voltage and resistance calibration source for on-site calibration of measuring instruments. The 515A provides direct and alternating voltage and resistance standards in a unit only 3½ inches high by 8½ inches wide by 16 inches deep. the instrument weighs just 13 pounds, including the rechargeable battery pack, which eliminates warm-up delays after transit and allows 8-hour operation free of line power for true portability. The 515A's basic uncertainty is specified over a temperature range of 18°C to 28°C for a 1-year period, thus making it easy to use in production test and calibration environments without complex correction terms. The long calibration cycle also makes the 515A economical to own by minimizing maintenance overhead costs.

All 515A outputs are available at a single set of output terminals. In addition, terminals are available to allow guarding and shielding of test leads in critical test situations.

If the unit is connected to the ac line, the internal battery is placed on charge; otherwise the 515A automatically operates from the battery and its state of charge is indicated on the meter to the right of the panel.

The 515A can be used effectively to test a wide range of characteristics in measuring instruments. Here are a few of the many applications:

Functions Checked

dV: Input offset current, a-d linearity, absolute accuracy
aV: Frequency response, converter linearity, residual noise, absolute accuracy
Resistance: Linearity, residual resistance, absolute accuracy
General: Zero offset and stability, autoranging, overranging

Specifications

Direct Voltage

Ranges
μV: 0 to 999 μV continuous (0.2 μV resolution)
1V: 0 to 1.0V in 0.1V steps
10V: 0 to 10V in 1V steps
100V: 100V cardinal point
Accuracy: (For 1 year, 18°C to 28°C, 30 min warm-up)
μV range: ±2 μV
1V, 10V, and 100V ranges: ±30 ppm or 30 μV of range, whichever is greater
Output Current: Function of source resistance, except 100V range which is limited at approximately 0.5 mA. No damage to instrument with short circuit on output
Source Resistance
μV, 1V, 10V ranges: 300Ω
100V range: <1Ω (up to 0.5 mA load)

Alternating Voltage

Range: 1V, 10V, 100V cardinal points
Output Frequencies
10V: 400 Hz, 4 kHz, 50 kHz
1V, 100V: 400 Hz
Accuracy: (For 1 year, 18°C to 28°C, 30 min warm-up)
1V: ±0.05%
10V: ±0.04% at 400 Hz and 4 kHz. ±0.1% at 50 kHz
100V: ±0.06%
Frequency Accuracy: ±1% except at 50 kHz ±5%
Total Harmonic Distortion and Noise: <0.03% (400 Hz and 4 kHz), <0.05% (50 kHz)
Output Current
1V, 10V output: 0 to 10 mA rms
100V output: 0 to 0.5 mA rms

Resistance

Range: 10Ω through 10 MΩ in decade steps + zero setting
Accuracy: (1 year, 18°C to 28°C, referred to "0"Ω position)
0Ω - Residual resistance is less than 0.15Ω
10Ω - 100Ω: ±0.06%
1 kΩ - 1 MΩ: ±0.015%
10 MΩ: ±0.075%
Power Rating: 0.2W or 100V (dc or rms), whichever is less

General Specifications

Temperature: 0°C to 50°C, operating
Power: 100, 115, 200, 230V ac, ±10%, 50 to 440 Hz, <10W, or internal batteries. Eight hours operation from batteries when fully charged
Weight: 5.9 kg (13 lb)
Size: 8.9 cm H x 21.6 cm W x 40.6 cm D (3.5 in H x 8.5 in W x 16 in D)
Included: Manual, power cord, batteries

Model

January 1986 prices

515A Calibrator	$3995

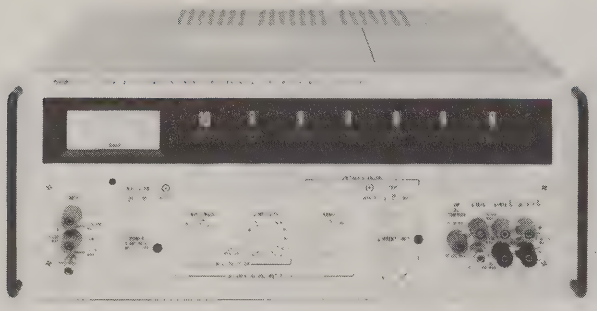
Accessories (Also see page 230)

M03-200-618 3" Rack Adapter, Dual	55
M03-200-619 3½" Rack Adapter, Offset	55
M03-200-620 Panel Mounting Kit	55
M03-203-700 Panel Protector	25

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

335A/335D



335A

335A & 335D DC Voltage Calibrators/Null Detectors

- 0 to 1100V output, 0 to 50 mA
- 0.1 ppm resolution, seven decades
- Built-in null detector for differential voltage measurements
- 10 ppm basic accuracy (335D)
- 5 ppm basic stability per month (335D)
- Overvoltage and overcurrent protection

Combining accuracy with versatility, Models 335A and 335D provide the functions of a precision direct voltage standard with those of a differential voltmeter and high impedance null detector. The only practical difference between the 335A and the 335D is their accuracy and stability.

Both instruments provide 0.1 ppm resolution, using seven in-line decade switches.

Specifications

Voltage Ranges: 10, 100, and 1000V with outputs as follows: 0 to 11.111110 (1 μV steps), 0 to 111.11110 (10 μV steps), 0 to 1111.1110 (100 μV steps)
Output Current: 0 to 50 mA

Accuracy of Output:* ±(% of Setting + μV)

Range	90 Days	60 Days
	335A	335D
10V	0.002 + 10	0.001 + 10
100V	0.002 + 20	0.001 + 20
1000V	0.002 + 200	0.0015 + 200

* *Also measurement accuracy of 335A and 335D used as a differential voltmeter*

Stability of Output: ±(% of Setting + μV)

Range	335A	335D
10V	±(0.001 + 10)/mo +(0.002 + 20)/yr	±(0.0005 + 7)/mo —
100V & 1000V	±(0.001 + 20)/mo ±(0.002 + 40)/yr	±(0.0005 + 30)/mo —

NOTE: The accuracy and stability are absolute, relative to NBS standards, and include effects of stability, line regulation, load regulation, and calibration uncertainties under standard reference conditions of 23°C ±1°C and up to 70% relative humidity.

Temperature Coefficient: (0.0002% of setting +1 μV)/°C from 22°C to 0°C or 24°C to 50°C
Overcurrent Protection: Limits current at 1 mA to 60 mA via continuously variable front panel control
Overvoltage Protection: Trips output if voltage level exceeds setting of front panel controls. Continuously variable from 10% to 110% of each range
Ripple and Noise: 10V range, ≤20 μV rms; 100V range, ≤30 μV rms; 1000V range, ≤40 μ rms
Settling Time: Typically within 10 ppm of final output less than 20s after a range change
Regulation: 0.0002% of setting or 10 μV for a 10% line voltage change or a full load change
Common Mode Noise Rejection: ≥140 dB from 0 to 400 Hz, up to 700V rms or 1000 dV
Isolation: Either output terminal may be floated up to 1000 dV from chassis ground
Remote Sense: Separate terminals are provided for sensing the output voltage directly at the load
Temperature: 0°C to 50°C, operating
Power: 115 or 230V ac ±10%, 40 to 60 Hz, approximately 130 VA fully loaded
Size: 17.8 cm H x 48.2 cm W x 45.7 cm D (7 in H x 19 in W x 18 in D)
335A and 335D Weight: 23 kg (50 lb)
Mounting: Standard 19" EIA relay rack, tapped for attachment of slides; resilient feet provided for bench use
Included: Manual, power cord

Models

January 1986 prices

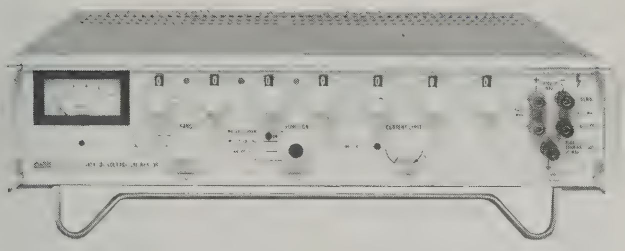
335A DC Voltage Calibrator/Null Detector	$8850
335D DC Voltage Calibrator/Null Detector	9480

Accessories (Also see page 230)

A60-01 17-20" Rack Slides	on req.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



343A

343A DC Voltage Calibrator

- 0 to 1100V output, 0 to 25 mA
- 0.1 ppm resolution, seven decades
- 20 ppm basic accuracy
- Stability better than 5 ppm/hour, 15 ppm/month

The 343A is a 7-digit instrument with a basic accuracy of 20 ppm and a resolution of 1 μV on the 10V range.

Cleanliness of the output is evident in the combined ripple and noise specifications of 50 μV rms from the 343A. Short term jitter and other random excursions are almost non-existent, less than 1 ppm.

A simple amplifier/comparator circuit is used to establish a convenient, variable current limiter. Any maximum current output from 1 to 30 mA may be set via a front panel control. In addition to providing for current protection to the load, a failsafe "crowbar" protects the series-pass elements from damage should the total voltage across the elements exceed a safe level.

Specifications

Output Voltage: 0 to 1100 dV
Resolution: 1 μV on 10V range, 10 μV on 100V range, 100 μV on 1000V range
Accuracy, 90 Days
10V Range: ±0.002% of setting or ±0.0002% of range*
100V Range: ±0.002% of setting or ±0.0001% of range*
1000V Range: Same as 100V range
**Whichever is greater*

NOTE: The above accuracies are absolute, relative to NBS standards, and include effects of stability, line regulation, load regulation, and calibration uncertainties under standard reference conditions of 23°C ±1°C and up to 70% relative humidity after 30 minute warm-up. Apply for 90 days.

Stability: ±% of Setting or ±Microvolts*

Time	10V Range	100V Range	1000V Range
Per Hour	0.0005% or 5 μV	0.0005% or 10 μV	0.0005% or 20 μV
Per Month	0.0015% or 15 μV	0.0015% or 25 μV	0.0015% or 50 μV
Per 6 Mo.	0.0025% or 30 μV	0.0025% or 40 μV	0.0025% or 60 μV

**Whichever is greater*

Temperature Coefficient: ±(3 ppm of setting +0.1 ppm of range +2 μV) per degree Celsius from 22°C to 15°C or 25°C to 35°C
Regulation: <0.0005% of setting +25 μV for a 10% line voltage change or a full-load to no-load change
Isolation: May be floated 500 dV from chassis
Settling Time: Within 15 ppm of final output in 5 seconds
Overcurrent Protection: Automatically limits output current at any preset level between 1 mA and 30 mA via continuously variable front panel control. Panel lamp illuminates during limiting
Meter: Switch-selectable to full range voltage or full range current
Remote Sense: Separate terminals are provided for sensing the output voltage directly at the load
Temperature: 0°C to 50°C, operating
Power: 115 or 230V ac ±10%, 50 to 440 Hz, approximately 60 VA fully loaded
Size: 8.9 cm H x 43.2 cm W x 45.7 cm D (3.5 in H x 17 in W x 18 in D)
Weight: 10.43 kg (23 lb)
Included: Instruction Manual

Model

January 1986 prices

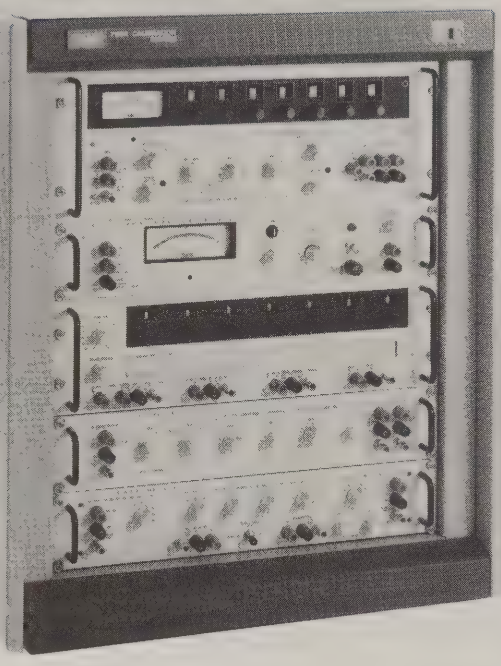
343A DC Voltage Calibrator	$4860

Accessories (Also see page 230)

MEE-7001 3½" Rack Adapter	115
MEE-8078 18" Rack Slides for rack adapter	130
MEE-8079 24" Rack Slides for rack adapter	140

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



7105A

7105A dV Calibration Instrument Cluster

- Cost-effective, high accuracy calibration
- Self-calibrating
- Expandable for aV calibration

The 7105A is a calibration system composed of five Fluke standards-type instruments mounted in a single benchtop cabinet. The system is "self-calibrating" and lets you achieve calibration accuracy equal to that found in standards laboratories. The 7105A is well known world-wide and is used extensively by electronic and electrical equipment manufacturers and government facilities.

Although the system is strictly for calibrating direct voltage sources, direct voltage meters, and the direct voltage value of resistors and dividers, the dV capabilities may be extended to aV calibration and measurement through the use of Fluke thermal transfer standards 540B, A55, A40, and A40A.

The instruments comprising the 7105A are:
Model 335A DC Voltage Standard/Null Detector
Model 845AR High Impedance Voltmeter/Null Detector
Model 750A Reference Divider
Model 720A Kelvin-Varley Divider
Model 721A Lead Compensator

Calibrate Voltage Sources and Voltmeters

Ultimate accuracy in voltage calibration is easily achieved using a two-step approach:

Step 1. Transfer the accuracy of the standard cells to the 10-volt output of a 732A Direct Voltage Reference Standard using a 720A Kelvin-Varley Divider and a null detector.

Step 1 Error Limits

Number of Standard Cells (n)	Limits of Error*
n = 4	0.6 ppm
n = 5	0.5 ppm
n = 6	0.4 ppm
n = 7	0.4 ppm
n = 8	0.4 ppm
n = 9	0.3 ppm

**Standard cell uncertainty not included*

Step 2. Calibrate the output of the 335A DC Calibrator, or any very stable power supply, using the 732A, the 720A, a null detector, and a 750A Reference Divider which has its 10V, 100V, 1000V, and 1100V ratios specially calibrated.

The limits of error for different voltage ranges are shown in the table below for these conditions:

- The 732A was calibrated using nine standard cells.
- The self-calibration of the 720A and the calibration of the 750A at the 10V and 100V, and the 10V, 1000V, and 1100V ratios was performed immediately prior.
- Ambient temperature remains stable within ±1°C.

Step 2 Error Limits

Voltage Range	Limits of Error*
≤10V	0.3 + (0.2 ÷ S) ppm
10V to 100V	3.3 to 1.5 ppm
100V to 1100V	4.3 to 2.5 ppm

**Standard cell uncertainty is not included*
S = Setting of Fluke 720A division ratio (0 to 1.0)

Below 10V, better accuracy may be achieved by using a different configuration of the 7105A System.

Calibrate Voltage Dividers

Using the 335A as a stable dV source and the 721A to compensate lead errors, a voltage divider may be checked. Specifications for the comparison are listed:

Absolute Linearity	0.1 ppm of input
Resolution	0.1 ppm of input
Input Taps	1.1 and 1.0
Maximum Input Volts	1.1 kV and 1.0 kV
Input Resistance	110 kΩ and 100 kΩ
Power Coefficient	0.1 ppm of input/W
Temp Coefficient*	0.1 ppm of input/°C
Stability*	1 ppm/yr

** 720A self-calibration removes linearity deviations caused by time or temperature*

Precision Differential Voltmeter

The system may be configured as a differential voltmeter obtaining 0.1 ppm resolution with the 720A Kelvin-Varley Divider. Both null detectors are used, one to compare the input voltage and one to continuously monitor standard cell EMF. Uncertainty is 5 ppm to 100V, to 20 ppm at 1.1 kV.

Model

January 1986 prices

7105A dV Calibration System (includes 7105A-502)	$23,250
7105A-502K Cabinet, with leads, accessories, 115V	1680
7105A/AA Cabinet, with leads, accessories, 230V	on req.

Selecting Calibrators and Standards

When selecting calibrators and standards, the most important consideration is your application. This would include such things as accuracy (or uncertainty), precision, and stability requirements and factors such as whether you will be doing calibrations on-site or in a lab, whether you need benchtop or rack-mounted instruments, and many other factors, including cost.

Once you know to what level of uncertainty the calibrations must be performed, you can begin to determine which calibrators, standards, and calibration systems are appropriate. This information can be obtained from this catalog, or your local Fluke Sales Engineer will be glad to assist you.

One rule-of-thumb ought to be followed: **the calibration process should be as simple as your application will allow.** The use of primary-level calibration instruments serves no useful purpose when calibrating instruments that don't require primary level calibration, such as a low accuracy handheld DMM.

The next consideration is whether your facility can maintain the environment required by your instruments. You will only be able to achieve specified uncertainty, precision, and stability if you adhere to the environmental constraints of temperature, relative humidity, and main supply voltage for your instruments. And with the growing move to on-site and mobile calibration, you will need to consider whether your instruments will be used only in the controlled environment of a lab, or if they will be going to the production floor and perhaps even further from the lab.

Finally you need to consider your metrology expertise. The lowest level of calibration uncertainty (highest accuracy) is achieved in a primary level lab, using high accuracy, extremely stable, precision single-function calibrators and standards. The metrology techniques required in these situations are extremely refined and sophisticated, and demand either a great deal of expertise or an automated approach that compensates for a lack of expertise.

Fluke can assist you with all these factors in your selection of calibration instruments. Fluke provides you with a broad spectrum of calibrators, standards, computer-aided calibration systems, and other related products so you know Fluke has the instruments that meet your needs.

And Fluke clearly defines the environmental specifications for our instruments so you can match your instrumentation needs to the environment of your calibration facility. Our instruments are very environmentally stable and rugged for using outside the lab. Calibration systems are available mounted in racks with pneumatic wheels so they can handle even the bumps of doorways and the production floor.

Fluke puts extra engineering effort into designing calibration instruments that are user-friendly and ergonomically suited to the calibration process. You will find our calibration instruments easy to learn and, perhaps more important, easy to use on a daily basis.

Fluke recognizes the importance of both manual and automated approaches to calibration, and offers you solutions that will match a need for either or both. Fluke instruments can be used manually or remotely via their IEEE-488 interfaces. The Fluke 7411A provides an approach to automation that lets you start with instruments you may already have in your lab, and add capability as your needs grow and budget becomes available.

Literature Guide

To help you learn more about calibration, Fluke offers a wide variety of literature on calibration and various related subjects. Your Fluke Sales Engineer can provide you with data sheets on specific products. And page 238 of this catalog lists all the technical literature available. Some specific items you may be interested in are described below. Contact your Fluke Sales Engineer for copies.

Fluke Calibration: Building Confidence Into Your Every Measurement describes how calibration fits into your everyday manufacturing environment. This brochure is specifically targeted towards those who are not familiar with calibration.

5440 Series: Complete Direct Voltage Calibration describes Fluke's line of calibrators, standards, and support products for complete direct voltage and resistance calibration. Information is included on how Fluke is traceable to the U.S. National Bureau of Standards (for direct voltage) using solid-state reference standards instead of saturated standard cells.

Computer-Aided Calibration explains how you can automate your lab, one step at a time, using your existing calibration instruments and Fluke calibration software. This brochure also explains how calibration systems can be custom-configured to meet your exact needs.

Calibration: Philosophy in Practice is a 100-page book describing various aspects of cal lab operation, types of instrumentation, and the theories underlying them. Information is included on basic units and standards of measurement, and how traceability is maintained to guarantee the integrity of your measurements.

Fluke-Equipped Traceable Lab describes how Fluke instruments fit various applications. Traceability charts are included and definitions of basic terminology.

Additional literature is available on financial analysis of your calibration needs, using and servicing specific products, and other special techniques. Consult your Fluke Sales Engineer.

AMPLIFIERS

Introduction

Amplifiers can be used with your calibrator to extend the direct and alternating voltage sourcing and current sourcing beyond the basic built-in capabilities of the calibrator. Amplifiers are controlled either from the calibrator's front panel or, in remote control and system applications, via the calibrator's IEEE-488 interface.

Fluke offers two Precision Power Amplifiers, the 5205A and 5215A, and one Transconductance Amplifier, the 5220A. Refer to the diagram below for information on which amplifiers are best suited to which Fluke calibrators.

Amplifier Interfacing Guide

	5100B	5200A	5440B	5442A
5205A Precision Power Amplifier	● *(1)*	●	● *(4)*	—
5215A Precision Power Amplifier	● *(2)*	●	X	X
5220A Transconductance Amplifier	● *(3)*	—	● *(5)*	—

● Programmable from source — May be manually interconnected X Not suitable for interconnection

(1) With Y5000 interface buffer and Y5001 cable

(2) With Y5000 interface buffer and Y5001 cable, but useable only for alternating voltage

(3) With Y5000 interface buffer and Y5002 cable

(4) With Y5001 cable

(5) With Y5002 cable

5205A

5205A Precision Power Amplifier

- Extends range of 5100 Series B, 5200A, 5440A, or 5440B calibrators
- Output voltages to 1100V rms, ±1500V dc
- Maximum output power 220 watts
- DC to 100 kHz, typical upper limit 120 kHz
- 420 ppm midband amplitude uncertainty at 1000V rms
- 200 ppm midband six-month stability
- Fully programmable
- Short and overload protected

The 5205A Precision Power Amplifier is a direct voltage coupled programmable inverting amplifier with a fixed gain of 100. Designed as a precision calibration amplifier, the 5205A is also useful as a general-purpose amplifier for a wide range of waveforms from 0 to 100 kHz. Alternating voltage output level is specified to 1100V at up to 200 mA, with a typical upper limit of 1200V before automatically tripping into standby mode. Direct voltage output level is specified to ±1500V at up to 100 mA, with a typical upper trip limit of 1600V.

The 5205A includes automatic-overload sensing and recovery. Upon sensing an excessive slew rate or frequency of the input signal, or a momentary output overload, output is returned to zero within 2 microseconds and held there for 6 milliseconds or until the fault is corrected. When a steady overload, shorted output, or excessive input drive level is detected, the 5205A trips and locks into standby mode and displays a fault indicator.

A calibrator interface is standard, including an independent input signal line. When used with a 5100 Series B, 5200A, 5440A, or 5440B Calibrator, the 5205A is controlled by the calibrator as an extension of its capabilities.

A remote control interface is also standard, and independent of the calibrator interface. This allows remote switching between the calibrator and an alternate signal input source through a front panel BNC connector.

Amplifier features of the 5205A include a gain uncertainty of as little as 0.04%, and a slew rate as high as 800 volts per microsecond.

The 5205A includes a 1-meter output cable with a protective shrouded connector. When used with a 5200A AC Calibrator, remote sensing is brought to this connection point for maximum accuracy. An insulated receptacle is provided on the front panel for safe storage of the output connector when not in use. Option 5205A-07, for system applications, moves this cable and the BNC amplifier input connector to the rear panel.

All calibration adjustments and lamp replacements can be performed without exposure to high voltage. The output amplifier and all of the printed circuit modules are easily removed for repair or exchange.

Calibration and Characterization

The 5205A is calibrated at the Fluke manufacturing facility by instrumentation traceable to the U.S. National Bureau of Standards. When ordered with a 5200A Alternating Voltage Calibrator, 5200A-900 characterization may be ordered including simultaneous characterization of the 5205A at points compatible with 5200A-800 software. See the 5200A Alternating Voltage Calibrator for more information.

Specifications, Calibrator Mode

Calibrator Mode

Amplitude Uncertainty With 5100 Series B Calibrator

Absolute Uncertainty*	
Frequency Hz	±(ppm setting + mV)
dc	700 + 20
50 - 10k	800 + 100
10k - 50k	1200 + 150

* *Traceable to U.S. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 20°C to 30°C, after 1-hour warm-up*

Amplitude Uncertainty With 5200A Calibrator

Basic Instrument Absolute Uncertainty*		Characterized Uncertainty**		
Frequency Hz	±(ppm setting + ppm range)	Frequency Hz	±(ppm setting + ppm range)	
			Relative	Absolute
10 - 30	1200 + 50	50 - 100	190 + 20	210 + 20
30 - 20k	400 + 20	100 - 10k	180 + 20	200 + 20
20k - 50k	800 + 50	10k - 20k	200 + 20	220 + 20
50k - 100k	1000 + 100	20k - 50k	310 + 30	630 + 30

* *Traceable to U.S. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques. 90 days, 18°C to 28°C, after 1-hour warm-up*

** *180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

Characterized-Point Absolute Uncertainty With 5200A:* ±ppm

Frequency, Hz							
50	100	200	1k	2k	10k	20k	50k
180	180	180	180	180	180	200	610

* *Traceable to U.S. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 18°C to 28°C, after 1-hour warm-up. Requires 5200A-900*

Amplitude Uncertainty With 5440A or 5440B Calibrator: Use amplifier-mode gain uncertainty specifications
Output Voltage Range: 100V to 1099.999V, ±dV or rms aV
Output Voltage Resolution: 1 mV with 5200A, 5440A, or 5440B; 10 mV with 5100 Series B
Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add ±(0.025 x uncertainty) per °C below 18°C or above 28°C

Stability With 5100 Series B, 5440A, or 5440B Calibrator: Use amplifier-mode gain stability specifications

Stability With 5200A Calibrator

Frequency Hz	10 Minutes	24 Hours	6 Months
	±(ppm setting + ppm range)		
10 - 100	0 + 50	100 + 0	200 + 0
100 - 20k	70 + 5	100 + 0	200 + 0
20k - 100k	70 + 5	200 + 0	400 + 0

* *Constant line, load, and temperature, total peak to peak random change in rms value*

Specifications, Amplifier Mode

Maximum Output Voltage: 1100V rms aV, ±1500V dV
Typical Overload Trip Voltage: 1200V rms aV, ±1600V dV
Maximum Input Voltage: 50V, dV or rms aV (without damage)
Frequency Range: 0 to 100 kHz
Typical Upper Trip Frequency: 120 kHz
Gain: X100, inverting

Gain Uncertainty

Maximum Load	DC to 20 kHz	20 kHz to 100 kHz
500Ω, 100 pF	±0.05%	±0.2%
5000Ω, 100 pF	±0.05%*	±0.15%
1 MΩ, 200 pF	±0.05%	±0.2%
1 MΩ, 500 pF	±0.06%	±0.4%
1 MΩ, 1000 pF	±0.08%	±0.8%
1 MΩ, 1500 pF	±0.1%	±1.2%

**±0.04%, dc to 10 kHz*

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add per °C below 18°C or above 28°C: dc to 20 kHz: ±(0.03 x uncertainty); 20 kHz to 100 kHz: ±(0.06 x uncertainty)

Gain Stability

Frequency Range	Max Capacitive Load	24 Hours	6 Months
dc to 20 kHz	1500 pF	0.03%	0.06%
20 kHz to 100 kHz	100 pF	0.08%	0.2%
20 kHz to 100 kHz	1500 pF	0.4%	0.8%

Maximum Slew Rates:*

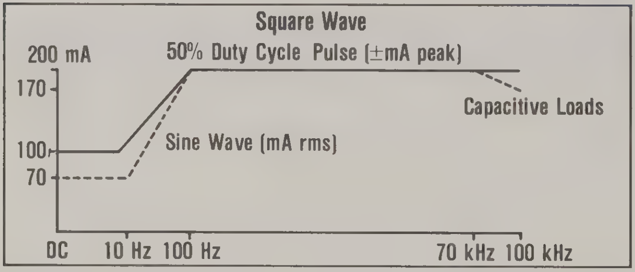
Maximum Load	Maximum Input Slew Rates	Maximum Output Slew Rates
200 mA Resistive	8.0V/μs	800V/μs
100 pF Capacitive	8.0V/μs	800V/μs
200 pF Capacitive	5.0V/μs	500V/μs
500 pF Capacitive	3.0V/μs	300V/μs
1000 pF Capacitive	2.0V/μs	200V/μs
1500 pF Capacitive	1.0V/μs	100V/μs

**Greater than 1000V output swing. Higher rates may trigger protection circuitry.*

Maximum Output Overshoot: Less than 4% of amplitude, with less than maximum input slew rate, and with greater than 1000V output swing
Maximum Isolation Voltage: Output common may be floated up to ±10V dV or rms aV from chassis to reduce common mode errors
Input Impedance: 10 kΩ in parallel with less than 120 pF
Input Connector: BNC, located on front panel. (Located on rear panel with Option -07)
Maximum Input Voltage: 50V dV or rms aV
Maximum Input Bias Current: 100 nA

General Specifications

Maximum Load Current: Bipolar Symmetrical Waveforms



Unipolar Rectangular Waveform:* ±200 mA peak with pulse width less than 5 msec; period greater than 10 msec. Linearly Derating To: ±100 mA peak with pulse width greater than 50 msec: period less than 100 msec

** Referenced to zero volts. Under all circumstances, output current capability is at least ±100 mA peak*

Maximum Capacitive Load: 1500 pF, not to exceed rated load current. (Example: maximum capacitive load at 1000V, 100 kHz is 270 pF
DC Offset Voltage: ±10 mV at the output*

**90 days, 18°C to 28°C, after 1-hour warm-up*

Total Harmonic Distortion:* Resistive loads greater than 1500Ω or capacitive loads less than 1000 pF

10 Hz to 20 kHz	0.05% of setting
20 kHz to 50 kHz	0.07% of setting
50 kHz to 100 kHz	0.1% of setting

Resistive loads less than 1500Ω or capacitive loads greater than 1000 pF

10 Hz to 10 kHz	0.05% of setting
10 kHz to 20 kHz	0.1% of setting
20 kHz to 50 kHz	0.17% of setting
50 kHz to 100 kHz	0.25% of setting

**Bandwidth 10 Hz to 1 MHz*

Overload Protection: Limit protection against input noise spikes, momentary output overloads, excessive input slew rate, and excessive input frequency. Trip protection against input overdrive, steady overloads, and short circuit.
Random Noise: Less than 100 mV rms, 1 MHz bandwidth
Line-Related Noise: Less than 50 mV rms
Line Regulation: ±10 ppm of setting for 10% change in line voltage
Input Power: 100V, 115V, 200V, 230V ac, ±10%, internal jumper selected, 50 Hz to 60 Hz, 1800 VA at full load. Receptacle on rear panel for calibrator power
Size: 26.7 cm H x 43.2 cm W x 62.7 cm D (10.5 in H x 17 in W x 24.7 in D)
Weight: 54.5 kg (120 lb)
Included: Instruction Manual, interface cable to 5200A

Model

January 1986 prices

5205A Precision Power Amplifier	$8950
5205A-07 With Rear Input/Output	8970

Accessories (Also see page 230)

Y5000 Interface Buffer for 5100 Sereis	555
Y5001 Interface Cable for 5100 Series, 5440A, or 5440B	250
M10-205-600 Rack Mount Kit for 5205A	105
M00-280-610 24" Rack Slides for rack adapter	110

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

5215A

5215A Precision Power Amplifier

- Designed for use with the 5200A Calibrator
- Output voltages to 1100V rms
- Maximum output power 220 watts
- 10 Hz to 100 kHz, typical upper limit 120 kHz
- 420 ppm midband amplitude uncertainty at 1000V rms
- 200 ppm midband six-month stability
- Fully programmable
- Short and overload protected

The 5215A Precision Power Amplifier is an aV coupled programmable inverting amplifier with a fixed gain of 100. AV output level is specified to 1100V at up to 200 mA, with a typical upper limit of 1200V before automatically tripping into standby mode.

The 5215A includes automatic-overload sensing and recovery. Upon sensing an excessive slew rate or frequency of the input signal, or a momentary output overload, output is returned to zero within 2 microseconds and held there for 6 milliseconds or until the fault is corrected. When a steady overload, shorted output, or excessive input drive level is detected, the 5215A trips and locks into standby mode and displays a fault indicator.

An interface for a 5200A Alternating Voltage Calibrator is standard, allowing the 5215A to be controlled by the calibrator as an extension of its capabilities.

The 5215A includes a 1-meter output cable with a protective shrouded connector. Remote sensing is brought to this connection point for maximum accuracy. An insulated receptacle is provided on the front panel for safe storage of the output connector when not in use. Option 5215A-07, for system applications, moves this cable to the rear panel.

All calibration adjustments and lamp replacements can be performed without exposure to high voltage. The output amplifier and all of the printed circuit modules are easily removed for repair ro exchange.

Calibration and Characterization

The 5215A is calibrated at the Fluke manufacturing facility by instrumentation traceable to the U.S. National Bureau of Standards. When ordered with a 5200A AC Calibrator, 5200A-900 characterization may be ordered including simultaneous characterization of the 5215A at points compatible with 5200A-800 software. See the 5200A Alternating Voltage Calibrator for more information.

Specifications

Amplitude Uncertainty

Basic Instrument Absolute Uncertainty*		Characterized Uncertainty**		
Frequency Hz	±(ppm setting + ppm range)	Frequency Hz	±(ppm setting + ppm range)	
			Relative	Absolute
10 - 30	1200 + 50	50 - 100	190 + 20	210 + 20
30 - 20k	400 + 20	100 - 10k	180 + 20	200 + 20
20k - 50k	800 + 50	10k - 20k	200 + 20	220 + 20
50k - 100k	1000 + 100	20k - 50k	310 + 30	630 + 30

** Traceable to U.S. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques. 90 days, 18° C to 28° C, after 1-hour warm-up*

*** 180 days, 18° C to 28° C, after 1-hour warm-up. Requires 5200A-900*

Characterized-Point Absolute Uncertainty:* ±ppm

Frequency, Hz							
50	100	200	1k	2k	10k	20k	50k
180	180	180	180	180	180	200	610

** Traceable to U.S. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 18° C to 28° C, after 1-hour warm-up. Requires 5200A-900*

Output Voltage Range: 100V to 1099.999V rms aV

Output Voltage Resolution: 1 mV with 5200A; 10 mV with 5100 Series, aV output only.

Temperature Coefficient: For 0° C to 18° C and 28° C to 50° C, add ±(0.025 x uncertainty) per °C below 18° C or above 28° C

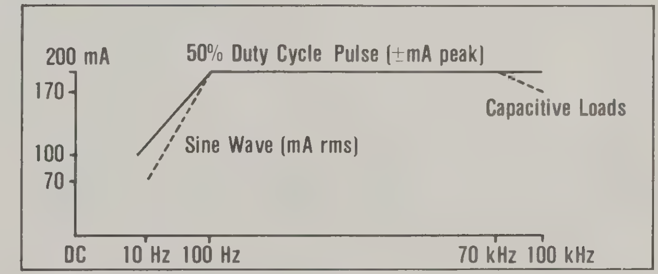
Stability

Frequency Hz	10 Minutes	24 Hours	6 Months
	±(ppm setting + ppm range)		
10 - 100	0 + 50	100 + 0	200 + 0
100 - 20k	70 + 5	100 + 0	200 + 0
20k - 100k	70 + 5	200 + 0	400 + 0

** Constant line, load, and temperature, total peak to peak random change in rms value*

Maximum Isolation Voltage: Output common may be floated up to ±10V dc or rms ac from chassis to reduce common mode errors

Maximum Load Current:



Maximum Capacitive Load: 1500 pF, not to exceed rated load current. (Example: maximum capacitive load at 1000V, 100 kHz is 270 pF

DC Offset Voltage: ±10 mV at the output*

**90 days, 18° C to 28° C, after 1-hour warm-up*

5215A

Total Harmonic Distortion:* Resistive loads greater than 1500Ω or capacitive loads less than 1000 pF:

10 Hz to 20 kHz	0.05% of setting
20 kHz to 50 kHz	0.07% of setting
50 kHz to 100 kHz	0.1% of setting

Resistive loads less than 1500Ω or capacitive loads greater than 1000 pF:

10 Hz to 10 kHz	0.05% of setting
10 kHz to 20 kHz	0.1% of setting
20 kHz to 50 kHz	0.17% of setting
50 kHz to 100 kHz	0.25% of setting

**Bandwidth 10 Hz to 1 MHz*

Overload Protection: Limit protection against input noise spikes, momentary output overloads, excessive input slew rate, and excesive input frequency. Trip protection against input overdrive, steady overloads, and short circuit
Random Noise: Less than 50 mV rms
Line Regulation: ±10 ppm of setting for 10% change in line voltage
Input Power: 100V, 115V, 200V, 230V ac, ±10%, internal jumper selected, 50 Hz to 60 Hz, 1800 VA at full load. Receptacle on rear panel for calibrator power
Size: 26.7 cm H x 43.2 cm W x 62.7 cm D (10.5 in H x 17 in W x 25 in D)
Weight: 54.5 kg (120 lb)
Included: Instruction Manual, interface cable for 5200A

Model

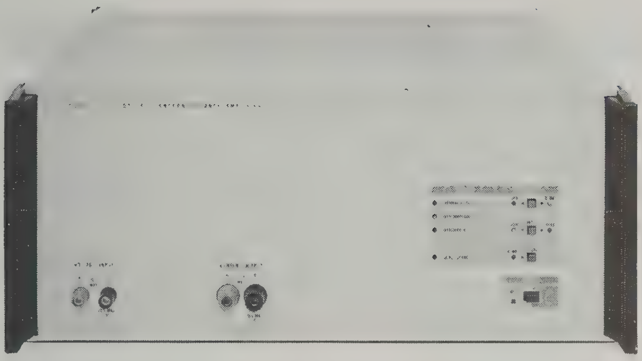
	January 1986 prices
5215A Precision Power Amplifier	$8290
5215A-07 Rear Only Output	8310

Accessories (Also see page 230)

M10-205-600 Rack Mount Kit for 5205A	105
M00-280-610 24" Rack Slides for rack adapter	110

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



5220A

5220A Transconductance Amplifier

- 20 amps output dc or rms ac
- 0.025% basic dc accuracy
- Over-voltage and over-current protection
- Over-temperature protection
- May be programmed through the 5100B Series B

The Model 5220A Transconductance Amplifier lets you calibrate alternating or direct current meters and shunts and the current functions of digital multimeters and VOMs that measure up to 20 amperes. A known input voltage of 1 to 20 volts produces a known output current of 1 to 20 amperes. The transconductance is 1 ampere per volt, either dc or rms ac from 30 Hz to 5 kHz.

The 5220A is designed to be controlled by the 5100B or 5101B Calibrator but may be driven by another voltage source such as the 5200A. When used with a 5100B or 5101B, the current range of those instruments is extended by a factor of 10 to 1. Also, options are available for the 5100B and 5101B that make the system compatible with IEEE Std 488-1978 or EIA Standard RS-232-C. A built-in mag casette tape for the 5101B can be used to record the calibration steps of each procedure then later can be used to repeat the procedure with very little operator expertise.

Built-in Protection

The 5220A is built to survive in the "real" world of practical, day-to-day use. Protection is designed in to eliminate problems caused by excessive inputs, open inputs, and overcompliance. Indicators on the front panel tell the user about any of these conditions. Automatic shut down occurs should the internal temperature rise excessively.

The Y5000 Interface/Buffer

Drive voltage to the 5220A may be introduced through the front panel or the rear panel. The connector on the rear, however, allows the 5220A to work with a 5100B (or 5101B) Calibrator through an Interface/Buffer (Y5000) and cable that attaches to the rear panels.

With the Y5000 Interface/Buffer, the two instruments operate as one integrated calibration system with all the advantages of single-control-point calibration: automatic error calculation, entry limit protection, etc.

A single Y5000 Interface/Buffer may be used to control and operate both a 5220A Transconductance Amplifier and a 5205A Power Amplifier from a 5101B (or 5100B).

Specifications

The specifications below apply for 180 days for instruments operated between 20°C and 30°C in a relative humidity of 70% or less.

Transconductance: 1 siemens (1 ampere per volt)

Output Range: 0 to 20A dc or rms ac (28.3A peak)

Maximum Compliance Voltage: $\geqslant \pm 4$V dc, or 3V rms ac (4.25V peak)

DC Accuracy: ±(0.025% of output +1 mA)

AC Accuracy: ±(0.05% of output +1 mA) from 30 Hz to 1 kHz, and ±(0.05% of output +1 mA) x f from 1 kHz to 5 kHz, where f = frequency in kHz

Short Term DC Stability: Output changes less than ±(0.005% +200 μA) in 10 minutes, with constant line, load, and temperature

Short Term AC Stability: Output changes less than ±(0.01% +500 μA) in 10 minutes, with constant line, load, and temperature

Harmonic Distortion and Noise: ±(0.05% of output ±1 mA) over frequency range of 30 Hz to 1 kHz and measured with a noise bandwidth of 300 kHz, ±0.05% of output + 1 mA) x f from 1 kHz to 5 kHz, where f = frequency in kHz

Temperature Coefficient: ±(0.0025% of output +100 μA) per degree C, above 30°C or below 20°C

Transient Recovery: Output will settle to within 0.01% of final value within 2 seconds following a programmed change in output current or frequency (10 ms for 5220A alone)

Load Capability: Drives all resistive and capacitive loads consistent with current and compliance voltage capability. Drives inductive loads (with reduced accuracy) up to 200 microhenries, consistent with current and compliance voltage capability

Maximum Isolation Voltage: ±20V dc or 20V ac rms

Temperature Range: 0°C to 50°C (operating) and −20°C to 65°C non-operating

Relative Humidity: ≤50% to 50°C, ≤75% to 40°C, ≤95% to 25°C

Altitude: 0 to 10,000 feet (operating) and 0 to 40,000 feet (non-operating)

Vibration: 2G maximum, 5 Hz to 55 Hz for 15 minutes

Shock: 15G maximum, half sinewaves

Power: 100, 110, 115, 120, 200, 220, 230, or 240V ac +10%, switch-selectable, 50 Hz to 60 Hz, 300 watts

Size: 17.8 cm H x 43.2 cm W x 55.9 cm D (7 in H x 17 in W x 22 in D), case only

Weight: 227 kg (50 lb)

Included: Manual, power cord

Model

January 1986 prices

5220A Transconductance Amplifier	$4795

Accessories (Also see page 230)

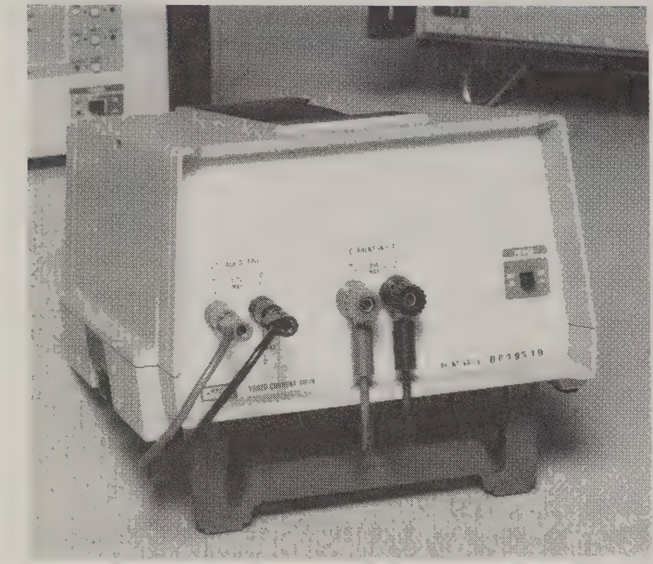
Y5020 Current Shunt	690
Y5000* Interface/Buffer	555
Y5002* Cable (Y5000 to 5220A)	235
M07-205-600 7" Rack Adapter	105
M00-260-610 18" Slides for Rack Adapter	105
M00-280-610 24" Slides for Rack Adapter	110

**Required when controlled from 5100B or 5101B*

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

Y5020



Y5020

Y5020 AC or DC Current Shunt

- Rated to 20A dc to 5 kHz
- 100 ppm uncertainty
- 10 milliohms nominal resistance
- Less than 250 mV burden

The Y5020 Current Shunt is a very stable, non-inductive, four-terminal resistive current shunt. It may be used to verify the accuracy of the 5220A Transconductance Amplifier or other current calibrators. It is an inexpensive method of accurately measuring current up to 20 amperes, from dc to 5 kHz. The 0.01Ω nominal resistance creates less than 250 mV burden. A forced-air cooling fan stabilizes internal ambient temperature during use.

Specifications

The following specifications apply for one year, provided the Y5020 is operated with its cooling fan in ambient temperatures from 18°C to 28°C. Voltage terminals must be connected to a measurement circuit with an input resistance of 1 MΩ or greater and a capacitance of 500 pf or less.

Nominal Resistance: 0.01Ω ±1%
Uncertainty:* Direct current, ±100 ppm; alternating current, ±(150 ppm + 120 ppm x frequency in kHz) relative to direct current specification
** Referenced to the certified absolute value of shunt resistance stamped on the front panel*

Stability: Less than 20 ppm resistance change in six months
Maximum Current: 20A direct current or rms alternating current
Burden Voltage: Less than 250 mV at 20 Amperes
Temperature Coefficient: Less than 20 ppm/°C; 18°C to 0°C and 28°C to 50°C
Power Coefficient: Less than 12 ppm per watt
Operating Temperature: 0°C to 50°C ambient
Storage Temperature: -40°C to 70°C
Input Power:* 115V or 230V ac ±10%, 11 watts
Size: 12.7 cm H x 20.5 cm W x 3.6 cm D (5.0 in H x 8.0 in W x 12.9 in D)
**For cooling fan. Specify 115V or 230V when ordering*

Model	January 1986 price
Y5020* Current Shunt	$690

**Specify supply voltage (e.g., Y5020-115 or Y5020-230)*

The Fluke Commitment to Calibration Leadership

The John Fluke Mfg. Co., Inc. is a major supplier of quality test and measurement instruments to the electronics industry. For 35 years Fluke has been a pioneer in providing state-of-the-art support for calibrations and standards laboratories. From dc calibrators to sophisticated multimeter calibration systems, Fluke has provided not only the finest instruments, but has also offered advanced laboratory standards, customer training, and conscientious after-sales support through an international network of service centers. Customers rely on Fluke products for dc and low frequency ac calibration because of Fluke's leadership in cost-effective performance, reliable specifications, and dependability.

Fluke is serious about calibration. You will find that Fluke products not only offer higher performance and more value, but fully satisfy your needs for traceable support equipment. Among the over 100 calibration products Fluke offers, a consistent characteristic has been technological leadership at the time of introduction. Others have followed Fluke's technological lead, but none can match Fluke's commitment to providing innovative calibration products and dedication to customer service and support both before and after the point of sale.

Fluke is committed to responding to your calibration needs.

Why Calibrate?

Calibration makes it possible to achieve accuracy, precision, and interchangeability. That enables science and technology, along with engineering and mass-production techniques, to make our world what it is today. Coupled with metrology, the "science of measurement," calibration is the foundation of our confidence in the electrical and electronic test and measurement instruments we use daily. If you are affected by government regulation such as, in the United States, MIL-STD-45662, NRC 10CFR50 Appendix B, or the Federal Food, Drug, and Cosmetic Act, then you are especially concerned with "calibration system requirements" and "traceability to the National Bureau of Standards."

Calibration Seminars

Fluke regularly presents seminars, "Calibration: Philosophy in Practice." This one-day seminar includes such topics as calibration terminology, history, traceability, the latest advances in dV and aV measurement techniques, and computer-aided calibration methods. Contact your local Fluke Sales Office or Technical Service Center and reserve your place in the next seminar in your area.

STANDARDS & AUXILIARY EQUIPMENT

Introduction

Local Primary Standards

Local primary direct voltage and resistance standards serve as the foundation for both direct and alternating voltage calibration. The accuracy of these standards is ensured by periodically submitting them to the National Bureau of Standards for comparison with their working standards. Temperature controlled saturated standard cells, four-terminal standard resistors (of the Thomas or NBS-type), and standard dividers provide calibration laboratories with the standards of voltage, resistance, and ratio they need. With them, accurate transfer of certified values may be made to calibrators, portable solid-state reference standards, and lower-echelon working standards and transfer standards. From these two local primary standards, voltages and resistances at other levels can be defined. Together, they define direct and alternating current.

Direct Voltage Reference Standards

Portable, solid-state dV reference standards, such as the Fluke 732A and 731B are designed to provide metrology laboratories, engineering areas and production test groups with a working standard of direct voltage that can be used in calibration, research and development. These standards provide the stability of standard cells without the problems associated with standard cells — such as intolerance to loading, vibration, and ambient temperature variations. There is an added advantage to working with a 10-volt reference instead of a 1-volt reference: Effects of noise and thermal emf are greatly reduced. The self-contained battery power supply and temperature-controlled oven of the 732A make this instrument suitable for the most exacting requirements of a precision transfer standard.

Alternating Voltage Reference Standards and Calibration

Calibration of aV instrumentation is especially complicated by the fact that there are no reproducible standards of alternating voltage. Since there is no aV counterpart to the standard cell, alternating voltages and currents must first be either rectified and converted to dV or compared to the heating effect of an equivalent direct voltage or current which may then be referred to an appropriate dV standard. A complication of the comparison process is knowing the frequency response of the converter. Fluke has, for many years, provided both aV and dV standards as well as the thermal transfer standards needed for comparing the aV standards to the dV standards.

Thermal transfer standards may be used to accurately measure an unknown alternating voltage or current by comparing the heating effect of the unknown with the heating effect of an equivalent direct voltage or current which is known. The Fluke 540B Thermal Transfer Standard provides this capability in an instrument designed for simple operation and wide dynamic range. For voltage measurements at frequencies above the 1 MHz range of the 540B, the A55 High Frequency Thermal Converters may be added to extend the range to 50 MHz. Alternating current measurement capability may also be added by means of the A40 and A40A shunts.

Fluke responded to the need for a precision fixed-frequency sinewave voltage source suited to calibration or reference applications with its 510A AC Reference Standard. In the calibration laboratory or out on the production floor, the Fluke 510A offers portability and an accurate 10V output available at any specified frequency from 50 Hz to 100 kHz. The 510A provides you with the ultimate in applications flexibility.

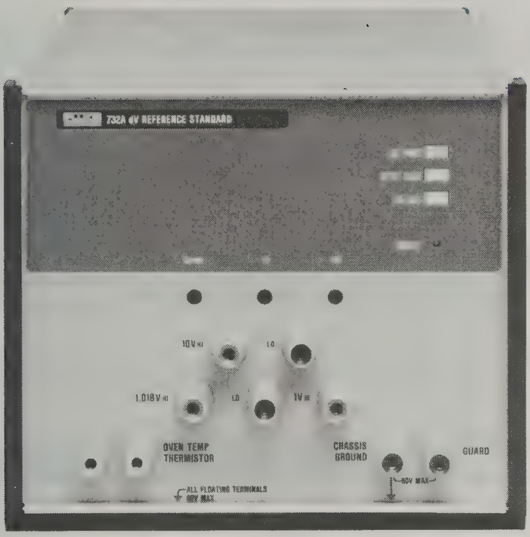
Calibration of aV devices and instrumentation up to 1200V rms and frequencies up to 1.2 MHz is available using the Fluke 5200A Precision AC Calibrator and a 5205A Precision Power Amplifier. Either an IEEE-488 interface or parallel interfacing is compatible. Fluke has designed this system to provide you with the option of either manual or semi-automated approaches to the calibration of aV voltmeters, DMMs, and other frequency-sensitive devices that require precision, variable frequency, and voltage stimuli.

DV Standards and Auxiliary Equipment

- 732A DV Reference Standard
- Transport Case and Battery Cahrger for 732A
- Direct Voltage Maintenance Program
- 752A Reference Divider
- 731A DC Reference Standard
- 750A Reference Divider
- 720A Kelvin-Varley Divider
- 721A Lead Compensator
- 845AB/AR Voltmeter/Null Detector

AV Standards and Auxiliary Equipment

- 510A AC Reference Standard
- 540B Thermal Transfer Standard
- A40/A40A Current Shunt
- A55 Thermal Converter



732A

732A dV Reference Standard

- 10V, 1V and 1.018V outputs
- 0.5 ppm stability per month
- 18°C to 28°C operation at full accuracy specs
- Short circuit proof
- Traceable calibration available through Fluke Direct Voltage Maintenance Program to NBS
- Line and rechargeable battery powered
- 12-hour battery life for calibration transfer

The Fluke 732A is a solid state, dV reference standard which provides significant performance improvements in stability, ruggedness, and transportability. Its 10V output offers better resolution, lower noise, and simpler operation than standard cells. The 732A also includes outputs of 1.0 and 1.018 volts.

The accuracy and stability of the 732A allows direct substitution for saturated standard cells in many applications. Its stability of 0.5 ppm for 30 days provides the confidence necessary to calibrate high-performance instruments. In addition, the use of the 10V output as a primary reference standard means that the effects of thermal emfs and noise are reduced.

The 732A can be shorted, even for extended periods of time, without damage and recovers without loss of stability. The unit may be powered by line voltage or will operate 12 hours on its internal battery — even longer on external batteries. Either line power or the battery may be removed without affecting the output.

Saturated standard cells are fragile and susceptible to shock and vibration during traveling. The 732A was designed for air or ground shipment with no special handling.

The internal oven has high thermal gain allowing full accuracy to be specified over an operating range of 23°C ±5°C. Therefore, this new reference standard may be used outside of the conventional standards laboratory environment in areas where saturated cells or other transfer standards would not be reliable.

The 732A dV Reference Standard was originally developed by Fluke to transfer the volt into our own manufacturing facility. The unprecedented success achieved by this effort led to the development of the 732A for the commercial market. Fluke has developed a worldwide network of regional support centers to provide calibration support for the 732A where local standards are not available. These centers maintain volt-transfer programs with the national standards laboratories.

Specifications*

Absolute Uncertainty: The 732A is normally delivered without absolute uncertainty specifications because, to maintain calibration as a traceable standard, the 732A must continue to receive uninterrupted operating voltage from line power or from the self-contained batteries, which provide approximately 12 hours of off-line operation. The 732A is normally shipped from the factory with the battery switch turned off. Upon receipt, the 732A must be powered up and stabilized for 24 hours before calibration against traceable standards. The absolute uncertainty specifications for the 732A must then relate to the uncertainty specifications of the traceable standards used for this calibration.

For a certified calibration by the Fluke Standards Laboratory and shipment under power, refer to the 732A-000 and 732A-100 options described under the Direct Voltage Maintenance Program, next page.

These specifications include effects of line voltage variations of ±10% and assume the 732A has been continuously powered.

Stability: Parts per million, 18°C to 28°C

Output	30 Days	90 Days	6 Months	1 Year
10V	±0.5	±1.0	±1.5	±3.0
1.018V	±1.5	±4.0	±6.0	±12.0
1V	±1.5	±4.0	±6.0	±12.0

Temperature Coefficient: ±0.05 ppm per °C for 10V range, ±1.0 ppm per °C for 1V and 1.018V ranges, from 18°C to 0°C or 28°C to 40°C
Output Adjustment: ±50 μV for 10V and 1.018V ranges, ±5 μV for 1.0V range
Output Impedance: ≤5 mΩ for 10V output, 1 kΩ for 1V and 1.018V outputs
Output Current: ≤12 mA at 10V output. Limited by 1 kΩ output impedance at 1V and 1.018V output
Output Protection: May be shorted indefinitely. Protected against high voltage input transients to 1100V
Load Regulation: ≤6 ppm at 10V output from 0 to 12 mA
Line Regulation: ≤0.05 ppm of output for ±10% line change
Output Noise: ≤1 μV rms at 10V output from 0.1 Hz to 10 Hz

**See the Direct Voltage Maintenance Program description on page 121 for the improved specifications and traceability which can be obtained for the 732A.*

General Specifications

Temperature: 0°C to 40°C, operating; 0°C to 50°C, non-operating (with internal battery pack switched off
Relative Humidity: ≤95% to 30°C, ≤75% to 40°C, non-condensing
Altitude: ≤3050m (10,000 ft) operating
Vibration: Per MIL-T-28800, Type III, Class 5, Style E
Safety: IEC 348, 2nd edition, 1978 and ANSI C39.5, 1980
Power: 100V, 120V, 220V, or 240V ac ±10%, 50 to 400 Hz or 24 to 30V ac 50 to 60 Hz. Also external 24 to 40V dc. Internal 24-V lead acid, gelled electrolyte battery operates for 12 hours at 23°C when fully charged. Trickle-charged continually when external power is applied
Size: 19.1 cm H x 22.1 cm W x 60.3 cm D (7.53 in x 8.69 in x 23.75 in)
Weight: 12.3 kg (27 lb)
Included: Instruction manual, line cord, adjustment tool

Models

January 1986 prices

732A DC Reference Standard	$3195
732A-000 With Special Calibration, shipped hot	3490
732A-100 With Calibration, Drift Certification, shipped hot	3745

Accessories (Also see page 230)

732A-7002 Transit Case	445
732A-7003 Battery Charger and Auxiliary Battery Case	1030
732A-7004 Rack Shelf (Holds 2 732As or 732A and 752A)	310
732A-7005 Replacement Battery Pack	340

After-Warranty Service (See page 227)

Transport Case and Battery Charger

The 732A-7002 Transport Case is a rugged, fiberglass, foam-lined case capable of holding a 732A dV Reference Standard and a 732A-7003 Battery Charger, complete with up to four 732A-7005 Battery Packs. The extra battery capacity of four Battery Packs plus the heat-conserving insulation of the foam lined case will extend the off-line operating time of the 732A to about 72 hours.

The 732A-7003 Battery Charger is specially designed to hold and charge from one to four Battery Packs with the proper constant current, constant voltage cycle to avoid damage from over-charging. Fully discharged batteries are returned to approximately 95% charge in 24 hours. The charger provides the necessary isolation diodes and interconnections to provide the optimum charge to battery packs which may have unequal capacities or states of charge and to connect the batteries to the 732A dc power input connector.

Specifications

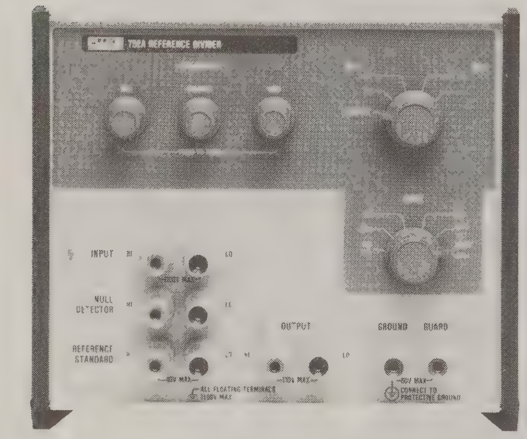
732A-7002 Transport Case
Size: 77 cm x 61 cm x 31 cm (30 in x 24 in x 12 in)
Weight: 12 kg (26 lb)

732A-7003 Battery Charger
Input Power: 100V, 110V, 115V, 120V, 200V, 220V, 230V, or 240V ac 10%, 50 to 400 Hz, 100W max
Size: 61 cm x 19 cm x 22 cm (24 in x 8 in x 9 in)
Weight: 5.9 kg (13 lb) alone; 23 kg (50 lb) when equipped with four battery packs (732A-7005)

Model

January 1986 prices

732A-7002 Transport Case	$ 445
732A-7003 Battery Charger	1030
732A-7005 Battery Pack	340



752A Reference Divider

- 10:1 and 100:1 division ratios
- Ratio accuracy of 0.2 ppm on 10:1 ratio
- Ratio accuracy of 0.5 ppm on 100:1 ratio
- Built in calibration bridge

The Fluke 752A Reference Divider sets new standards for direct voltage ratio accuracy and ease of use. It offers two divider outputs, 10:1 and 100:1 with output uncertainties of less than 0.2 ppm and 0.5 ppm respectively.

Before each use, the 752A is easily calibrated with only a stable voltage source and null detector. The entire procedure requires only five minutes and does not require external standards.

The 752A also includes internal switching for calibrating the 100 mV, 1V, 10V, 100V, and 1000V ranges of a voltage calibrator to a 10V reference source (such as the Fluke 732A dV Reference Standard) without having to change the lead connections. It provides the voltage division capability required to calibrate state-of-the-art calibrators and similar instruments.

A "self-calibration" procedure allows you to compensate for long term changes in value of the divider resistors by switching their positions in various Wheatstone bridge configurations and using the BALANCE pot on the front panel.

Specifications

These specifications apply for the lifetime of the instrument over the temperature range of 18°C to 28°C.
Ratio Ranges: 10:1 and 100:1
Ratio Accuracy: The following table specifies the ratio accuracies of the 752A that apply for a temperature variation of less than ±1°C from the self-calibration temperature (between 18°C and 28°C) for up to 8 hours following self-calibration.

Range	Input Voltage	Output Uncertainty	Null Accuracy*
10:1	100V	0.2 ppm	±0.5 μV
100:1	1000V	0.5 ppm	±1.0 μV

**Null accuracy refers refers to the required accuracy of the null detector reading during self-calibration*

Temperature Coefficient: ⩽±1 ppm per °C over range of 18°C to 28°C. Typically 0.1 ppm per °C from 15°C to 30°C
Input Resistance:
10:1 Ratio: 380 kΩ ±1%
100:1 Ratio: Divider is 4 MΩ; Driven Guard is 4 MΩ; total is 2 MΩ ±1%
Maximum Input Voltage: 200V for the 10:1 ratio; 1100V for the 100:1 ratio
Power Coefficient: ⩽0.05 ppm of output with 100V applied for 10:1 ratio and ⩽0.3 ppm of output with 1000V applied for 100:1 ratio included in the ratio accuracy specifications
Temperature: 0°C to 50°C, operating; -40°C to 75°C non-operating
Relative Humidity: ⩽75% to 40°C, ⩽45% to 50°C, non-condensing
Altitude: ⩽3050m (10,000 ft) operating; ⩽12,200m (40,000 ft) non-operating
Vibration: Per MIL-T-28800C, Type III, Class 5, Style E
Safety: IEC 348, 2nd edition, 1978; ANSI-C39.5, 1980
Size: 19.1 cm H x 22.1 cm W x 60.3 cm L (7.53 in x 8.69 in x 23.75)
Weight: 8.4 kg (18.5 lb)
Included: Instruction manual

Model

January 1986 prices

752A Reference Divider	$4295

Accessories (Also see page 230)

5440A-7002 Low Thermal Cables	325

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

Direct Voltage Maintenance Program

- Volt traceability for your calibration laboratory with significant cost reductions over direct NBS calibration
- Uncertainty within a few tenths of a ppm
- Complies with MIL-STD-45662
- Avoid investing in redundant hardware: your equipment never needs to leave your laboratory
- No possibility of accidental loading and destruction as with saturated standard cells

Built around the 732A Direct Voltage Reference Standard, the Fluke Direct Voltage Maintenance Program (DVMP) provides state-of-the-art uncertainty for your own laboratory, traceable to the U.S. National Bureau of Standards (NBS). The 732A is a solid-state direct voltage reference standard which enables voltage transfers with uncertainties of only a few tenths of a ppm, while meeting the requirements for ruggedness and a range of operating temperatures. This level of performance is made possible by the low, predictable drift rate, allowing accurate extrapolation of the output voltage to be made over long time intervals. With the DVMP, dissemination of the legal volt can be easily accomplished with an uncertainty of less than one ppm.

Traceability

Traceability to the legal volt is the principle objective of the DVMP. The Fluke Primary Standards Laboratory in Everett, Washington (U.S.A.) maintains traceability to NBS and other national standards laboratories at the 10 volt level. Fluke establishes a "Traceability Plane" for you consisting of the mean (average) of the reference voltages maintained by your participating laboratories.

Six Services to Choose From

The Fluke Direct Voltage Maintenance Program consists of four calibration services, resulting in six possible options, which can be used separately or in combination, depending on your needs. Two of the services are calibrations, performed completely by Fluke personnel, in the Fluke Standards Lab. These calibrations may be ordered as an option on a new 732A or as an option to be added to a 732A purchased previously. The other two calibration services are performed by the user, using a Fluke-owned standard, at the user's site, with the data transmitted to the Fluke Standards Lab for reduction and analysis. Complete description of the options follows:

1. **Option 732A-000.** Order this option to have an output voltage calibration performed on a newly ordered 732A. Before shipment, your new 732A will be compared to the direct voltage standards maintained in the Fluke Primary Standards Laboratory which are regularly compared to the Legal Voltage Standards maintained by the U.S. National Bureau of Standards. A report of calibration, listing the deviation from the nominal and the uncertainty of calibration is delivered with the instrument. The instrument will be delivered under power from self-contained and auxiliary batteries to insure the calibration.
2. **Option 732A-000R.** This is the option to order for calibration or re-calibration of a 732A purchased previously. Your 732A, when returned to the factory, will receive the same calibration as detailed under 732A-000 above, and will be returned to you under power.
3. **Option 732A-100.** Order this option to have a new instrument calibration for output voltage and characterized for drift rate before shipment from the factory. Your new 732A will be tested for both output voltage and drift rate by comparison against traceable standards for a period of 60 days in the Fluke Primary Standards Laboratory. Knowing the drift rate, the total uncertainty as a function of time is much reduced. A report of calibration, listing output voltage, drift rate, and uncertainties is delivered with the instrument which is delivered under power.
4. **Option 732A-100R.** This is the option to order for output voltage calibration and drift rate testing of a 732A purchased previously. Your 732A, when returned to the factory, will receive the same calibration and 60 day drift rate characterization as detailed under 732A-100 above, and will be returned to you under power.
5. **Option 732A-200.** This is the option to order for calibration of your 732A in your own laboratory. A Fluke-owned, calibrated 732A, together with all necessary connecting cables and clear operating instructions, will be sent to your site for comparison with your reference standard. A series of readings you make over a period of five days is recorded and returned to Fluke for evaluation at the Fluke Primary Standards Laboratory. A value is then assigned to your 10 volt standard, relative to the legal volt, and a report of calibration is returned to you. The quoted price for the 732A-200 option includes the shipping costs for the Fluke-owned 732A.
6. **Option 732A-201.** If you have more than one 732A in your lab, this is the option to order for calibration of each additional reference at the same site (must be ordered with Option 732-200). Data collected by the user will be reduced and evaluated by the Fluke Standards Lab, and a report of calibration issued for the reference standard.

Specifications

Option Number	Calibration Uncertainty (CU)*	Drift Rate Uncertainty (DU)**			Total Uncertainty
		30 Days	90 Days	1 Year	
732A-000	0.6 ppm	0.5 ppm	1.0 ppm	3.0 ppm	$[(CU)^2+(DU)^2]^{1/2}$
732A-100	0.6 ppm	0.35 ppm	0.5 ppm	1.5 ppm	
732A-200	0.6 ppm	**	**	**	

**Typical 99% confidence level; actual uncertainties determined at the time of test*

***Drift rate uncertainty will be established with repeated participation in the DVMP*

How To Order

Note: At the present time, due to the difficulty in making timed shipment to international customers, calibration services requiring hot shipment are only available in the U.S.

It is important to recognize that proper timing and coordination of the activities between Fluke and your firm are essential to successful delivery of a 732A under power. Following receipt of an order for one of the DVMP services, you will be contacted directly by Fluke factory personnel. For this reason the following information must be included with each order:

- The option number ordered.
- If options 732A-000R or 732A-100R are ordered, include the serial number of the instrument to be returned to Fluke for the service.
- The exact address where the shipment will be received.
- The name and telephone number of the person who will be responsible for receiving the shipment and connecting it to the power line when it arrives.
- The name and telephone number of an alternate responsible person if the first designated individual is unavailable.
- Any restrictions on hours of the day during which receiving can take place.
- Fluke guarantees arrival of the instrument under power. If it is delayed, Fluke or the carrier will pay the shipping charges for return of the instrument to Fluke for recalibration.

Options

January 1986 prices

732A-000 With Special Calibration, shipped hot	$3490
732A-000R Special Calibration, shipped hot	295
732A-100 With Calibration, Drift Certification, shipped hot	3745
732A-100R Calibration, Drift Certification, shipped hot	550
732A-200 On-Site 10V Certification w/Fluke Standard (includes shipping charges)	495
732A-201 Certification of Additional Reference/Same Site	125

731B

731B DC Reference Standard

- Outputs at 10, 1, 1.018, and delta E
- 10 ppm output accuracy
- Guarded floating output up to 500V above ground
- Line and battery powered

The Fluke Model 731B DC Reference Standard is a versatile instrument providing stability, while utilizing the excellent performance capabilities of solid-state technology. The instrument furnishes a variety of precision voltages with switched output ranges including 1.0, 1.018+ΔE, 10.0, and Δ E volts. Delta E (ΔE) provides a variable output of 0 through 999 μV which is either added to the voltage of a standard cell transfer or may be used directly as a low-level, stable direct voltage source.

Specifications

Output Ranges: 10V, 1V, 1.018 +ΔE, 1.019+ΔE, ΔE
Output Accuracy:*

Range	30 Days	90 Days	1 Year
10V	±10 ppm	±15 ppm	±30 ppm
1V	±10 ppm	±15 ppm	±30 ppm
1.018 + ΔE	±10 ppm	±15 ppm	±30 ppm
1.019 + ΔE	±10 ppm	±15 ppm	±30 ppm
ΔE	—	—	±2 μV

**Absolute accuracy at 23° C ±1° C after 30 minutes warm-up*

Transfer Accuracy (Stability)

Between	4 Hours
Standard cells on 1.018V + ΔE ranges or 1.019V + ΔE ranges	2 ppm
Standard cell and 1V output	3 ppm
10V output and standard cell or 1V output	5 ppm

Source Resistance: 10V range is <0.07Ω. The 1V, 1.018V, 1.019V, and ΔE Ranges are <1 kΩ
Output Protection: The output may be shorted indefinitely without damage to instrument
Line Regulation: <1 ppm for ±10% line voltage variation
Ripple & Noise: <1 ppm peak-to-peak 0 to 1 Hz, <20 μV rms 1 Hz to 1 MHz, except <70 μV rms at 10V output
Common Mode Noise Rejection: ⩾120 dB at 0 Hz, ⩾100 dB at 60 Hz, ⩾85 dB at 400 Hz
Isolation: Output may be floated up to 500 dV between chassis ground and guard
Temperature: 0°C to 55°C, operating
Power: 115V or 230V ac ±10V, 50 to 400 Hz or internal rechargeable batteries, 6W max, 120 mA max
Size: 8.8 cm H x 10.7 cm W x 30.4 cm D (3.5 in x 4.5 in x 12 in)
Weight: 2.26 kg (5 lb)
Included: Manual, power cord, batteries

Model

January 1986 prices

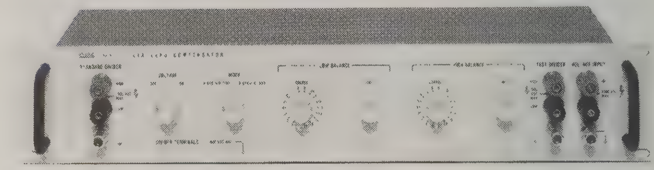
Model	Price
731B DC Reference Standard	$1595

Accessories (Also see page 230)

Model	Price
M03-201-601 3½" Rack Adapter, Single	105
M03-202-603 3½" Rack Adapter, Dual	105
M03-206-604 3½" Rack Adapter, Triple	105
M03-205-605 3½" Rack Adapter, Quad	85

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



721A

721A Lead Compensator

The 721A Lead Compensator equalizes the voltage drop across two resistive dividers connected in parallel for calibration. The errors due to contact and lead resistance are eliminated.

Specifications

Resolution of Resistance Compensation: 0.1 mΩ
Maximum Ratio Between Divider Resistance: 4000:1
Maximum Allowable Lead Resistance: 150 mΩ
Maximum Divider Voltage: 1500V dc
Size: 8.9 cm H x 48.2 cm W x 15.2 cm D (3½ in x 19 in x 6 in)
Weight: 2.72 kg (6 lb)
Included: Manual

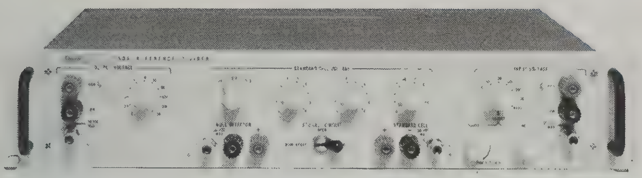
Model

January 1986 prices

Model	Price
721A Lead Compensator	$1390

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



750A

750A Reference Divider

- 10 ppm basic division ratio accuracy
- Switched input and output ranges
- Built-in kV for standard cell reference
- Overvoltage protection to 2 kV, any range

Model 750A Reference Divider is an extremely accurate and stable voltage divider for calibration of precision meters, calibrators, etc. The instrument is a 10 ppm (0.001%) divider with switched input taps ranging from 1100 to 1.1V, and switched output taps ranging from 1100V to 0.1V.

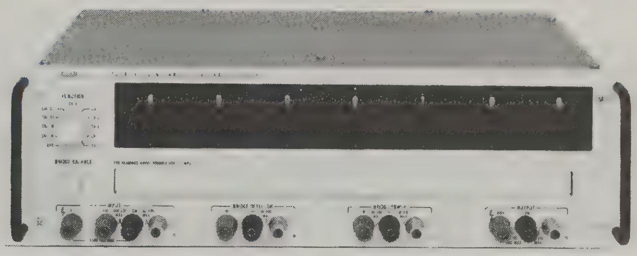
Specifications

Input Voltages: (Switched) 1.1, 5, 10, 50, 100, 500, 1000, 1100V
Output Voltages: (Switched) 0.1, 0.5, 1, 1.1, 5, 10, 50, 100, 500, 1000, 1100V
Standardizing Output: 1.017000 to 1.019999 dV in 1 μV steps
Division Ratio Accuracy and Stability: (Referenced to Standard Cell tap) ±(0.001% of output +0.5 μV) for 1 year
Calibration: All ranges above 1.1V are adjustable ±10 ppm
Calibration Resolution: 0.2 ppm
Divider Current: 1 mA nominal
Input Current Adjust: Coarse and fine front-panel rheostats provide an input voltage adjustment span of 10 mV with better than 1 μV resolution
Overvoltage Protection: Up to 2 kV may be applied on any range without damage
Power: Two 6.75V mercury batteries (1 year life)
Size: 8.8 cm H x 48.2 cm W x 33.0 cm D (3½ in x 19 in x 13 in)
Weight: 7.25 kg (16 lb)

Model	January 1985 prices
750A Reference Divider	$3995

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



720A

720A Kelvin-Varley Divider

- 0.1 ppm resolution, seven decades
- 0.1 ppm of input absolute linearity
- Built-in self calibration bridge
- Front panel self calibration

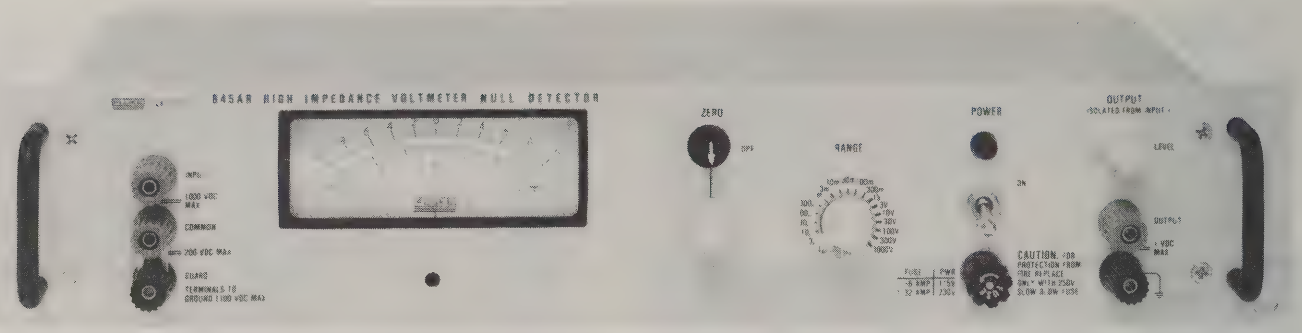
Model 720A Kelvin-Varley Divider is a high-resolution primary ratio standard with absolute linearity of 0.1 ppm, temperature coefficient of linearity of 0.1 ppm/°C, and self-calibration capability.

Specifications

Ratio Range: 0 to 1.0 (1.0 input tap) and 0 to 1.1 (1.1 input tap)
Resolution: 0.1 ppm of input with seven decades
Absolute Linearity: (At calibration temperature and without the use of a correct chart) ±0.1 ppm of input at dial settings of 1.1 to 0.1, $\pm 0.1(10S)^{1/3}$ of input at dial settings (S) of 0.1 to 0
Absolute Linearity Stability: (Without self-calibration) ±1.0 ppm of input/yr at dial settings of 1.1 to 0.1, $\pm 1.0(10S)^{2/3}$ ppm of input/yr at dial setting (S) of 0.1 to 0
NOTE: Absolute linearity is defined as the linearity between max and min output voltages. The self-calibration procedure may be used at any time to reset absolute linearity to ±0.1 ppm of input
Temperature Coefficient of Linearity: ±0.1 ppm of input/°C maximum at dial settings of 1.1 to 0.1
Short-Term Linearity Stability: Under typical conditions in a standards laboratory environment (temperature maintained within ±1°C) and with an applied voltage of up to 100V, stability of linearity is 0.1 ppm/30 days
Power Coefficient of Linearity: ±0.2 ppm of input/W max at dial settings of 1.1 to 0.1; $\pm 0.2\,(10S)^2$ ppm of input/W max at dial settings (S) of 0.1 to 0
Maximum End Errors: Zero error at output low: 0.004 ppm of input. Zero error at input low: 0.05 ppm of input. Full-scale error: 0.05 ppm of input
Thermal Voltages: ±0.5 μV max
Maximum Input Voltage: 1000V on 1.0 input terminal, 1100V on 1.1 input terminal
Input Resistance: 100 kΩ ±0.005% at 1.0 input terminal at 25°C; 110 kΩ ±0.005% at 1.1 input terminal at 25°C
Temperature Coefficient of Input Resistance: ±1 ppm per °C max
Size: 14 cm H x 48.2 cm W x 33 cm D, rack-mounted (5.5 in H x 19 in W x 13 in D)
Weight: 8.16 kg (18 lb)
Included: Manual

Model	January 1986 prices
720A Kelvin-Varley Voltage Divider	$5995

After-Warranty Service (See page 227)



845AR

845AB & 845AR Null Detector

- 19 ranges from 1 μV through 1000V
- Input isolation greater than 10^{12} ohms
- Input may be floated to 1100V above ground
- Overload protected to 1100V on all ranges
- Recorder output isolated from input

The Fluke 845AB and 845AR are solid-state null detectors designed for extremely high input impedance, sensitivity, and isolation. Model 845AB operates either from the line or from built-in rechargeable batteries. Model 845AR is a line-powered rack-mounting version, with a height of 3½ inches. Source loading through leakage is virtually eliminated by input isolation of 10^{12} ohms regardless of power line, chassis ground, or guard connections. Recorder output provides ±1V for end-scale deflection with ±0.5% linearity and does not affect input isolation. The 845AB and 845AR are capable of being floated up to 1100V from ground at either input terminal when used in a bridge circuit to compare voltage divider ratios. The unit withstands overloads up to 1100V on any range with a typical recovery time of four seconds.

Specifications

Range: 1 μV through 1000V dV end-scale in nineteen ranges, using 1, 3, 10 progression

Input Resistance: 100 MΩ on 300 mV range and above. 10 MΩ on 3 mV through 100 mV range, 1 MΩ on 1 mV range and below

Accuracy: Model 845AB ±(2% end-scale +0.1 μV). Model 845AR ±(3% end-scale +0.1 μV)

Maximum P-P Meter Noise: 0.20 μV on 1 μV range, 0.25 μV on 3 μV range, 0.3 μV on 10 μV to 1000V range, with input shorted

Input Isolation: Better than 10^{12} ohms at ≤50% relative humidity and 25°C regardless of line, chassis, or recorder grounding. Better than 10^{10} ohms up to 80% relative humidity and 35°C. With driven guard, isolation improves to at least 10^{13} ohms. Either input terminal can be floated 1100V off chassis ground

DC Common Mode Rejection: Better than 160 dB, input short-circuited, ≤80% relative humidity; better than 140 dB, open-circuited, ≤50% relative humidity; better than 120 dB, open-circuited, ≤80% relative humidity

AC Common Mode Rejection: (Below 100 kHz) 100V rms or 120 dB greater than end-scale, whichever is less, will affect reading <2% of end-scale (input open-circuited)

AC Normal Mode Rejection: (60 Hz and above) ac voltages 60 dB above end-scale will affect reading <2% of end-scale. Maximum voltage not to exceed 750V rms

Recorder Output: ±1V dc at full scale deflection. Linearity, 0.5%. Output impedance, 5K to 7.5K. Recorder output is isolated from input and is referenced to ground

Stability of Zero: Better than 0.15 μV/hour; better than 0.3 μV/day

Overload Capability: Up to 1100V dc may be applied on any range. Typical recovery time is 4s

Power, Model 845AR: 115 or 230V ac ±10%, 50 to 440 Hz, approx. 3W

Power, Model 845AB: 115 or 230V ac ±10%, 50 to 440 Hz or rechargeable battery. Approximately 6W during recharge. 40 hr operation on full charge. Batteries trickle-charge while instrument operates from power line

Size, Model 845AB: 17.8 cm H x 21.6 cm W x 20.3 cm D (7 in H x 8.5 in W x 8 in D)

Size, Model 845AR: 8.9 cm H x 48.3 cm W x 21 cm D (3.5 in H x 19 in W x 8.25 in D)

Weight: Model 845AB: 4.65 kg (10.25 lb); Model 845AR: 4.08 kg (9 lb)

Model

January 1986 prices

845AB	Voltmeter/Null Detector with batteries	$2000
845AR	Voltmeter/Null Detector	1860

Accessories (Also see page 230)

881A-102	7" Rack Adapter, Single	145
881A-103	7" Rack Adapter, Dual	100

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

510A

510A AC Reference Standard

- Uncertainty to ±100 ppm
- Optional battery operation
- Output voltage 10V rms
- Output current levels to 10 mA rms
- Fixed frequency, 50 Hz to 100 kHz

The 510A is a precision, fixed frequency, alternating voltage source designed for use as an amplitude calibration standard for test applications. In the calibration laboratory, the 510A provides an accurate aV reference for calibrating both true rms and average-sensing aV voltmeters. On the production line, the 510A can be used to rapidly verify aV test instrumentation or to generate a precise aV stimulus for circuit testing.

Output of the 510A is both fixed frequency and fixed amplitude. The frequency may be varied ±1% of center frequency with a front panel screwdriver adjustment.

Total harmonic distortion is less than 50 ppm up to 10 kHz, and less than 300 ppm at 100 kHz. This assures a pure sinewave for calibrating average, peak, or true rms reading aV-to-dV converters.

The optional rechargeable battery pack provides up to 16 hours of operation independent of line power. A front panel display provides a continuous display of battery condition. When operated from line power, the battery is maintained at full charge. The battery automatically operates the 510A whenever line power is removed.

Up to four 510As may be bolted together for mounting in a standard rack. Output terminals are provided on both the front and rear panels for easy access in both bench and system applications.

Specifications

Output Voltage: 10V rms
Output Current: 10 mA rms, short-circuit protected
Frequency: Any specified single frequency from 50 Hz to 100 kHz. Standard frequencies are: 50, 60, 400, 1000, 2400, 5000, 19,200, and 100,000 Hz

Amplitude Uncertainty:* ±ppm

Frequency	24 Hours	30 Days	90 Days
50 Hz to 20 kHz	100	150	200
20 kHz to 50 kHz	150	250	350
50 Hz to 100 kHz	400	500	600

**After 10-minute warm-up in ambient temperature 21° C to 25° C*

Amplitude Stability: ±ppm

Frequency	24 Hours	30 Days	90 Days
50 Hz to 20 kHz	20	50	100
20 kHz to 100 kHz	40	100	200

Total Harmonic Distortion: Less than 50 ppm to 10 kHz; less than 300 ppm at 100 kHz
Center Frequency Uncertainty: ±0.1%, adjustable ±1%
Frequency Stability: 500 ppm per mo
Load Regulation: ≤20 ppm to 10 kHz; ≤80 ppm at 100 kHz
Line Regulation: ≤10 ppm for ±10% line change
Input Power: 115 or 230V ac ±10%, 50 to 500 Hz, or optional rechargeable batteries
Size: 8.8 cm H x 10.7 cm W x 30.4 cm D (3.5 in H x 4.25 in W x 12 in D)
Weight: 2.26 kg (5 lb)
Included: Instruction Manual

Model

January 1986 prices

510A* AC Reference Standard	$1600
510A-01* AC Reference Standard w/battery pack	1825
510A/SF* AC Reference Standard (Special Frequency)	on req.
510A-01K Rechargeable Battery Pack (for retrofit)	375

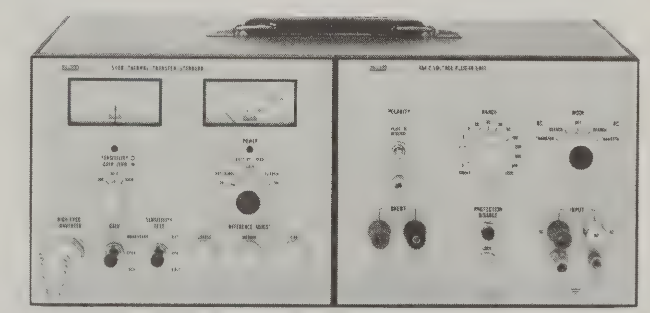
**Specify output frequency when ordering*

Accessories (Also see page 230)

M03-201-601 Rack Mount Kit, Single	105
M03-202-603 Rack Mount Kit, Dual	105
M03-206-604 Rack Mount Kit, Triple	105
M03-205-605 Rack Mount Kit, Quad	85

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



540B

540B Thermal Transfer Standard

- 100 ppm aV/dV transfer uncertainty
- Less than 100 ppm dc reversal error
- Frequency range 5 Hz-1 MHz
- Overvoltage protection
- Polarity reversal switch

The Fluke 540B is a thermal transfer instrument for precise measurement and calibration of alternating voltage and current. The 540B is designed for simple operation with positive protection from overloads. Voltage transfers may be made from 0.25V to 1000V rms in 14 ranges, with a frequency range from 5 Hz to 1 MHz. Each range maintains specified accuracy down to half of range. Resolution of input per scale division varies from 12 ppm at full range to 60 ppm at half of range. Basic

540B/A40/A40A

aV to dV transfer uncertainty is 100 ppm (±0.01%) without the use of calibration curves or correction tables.

The thermal element in the 540B is a specially constructed vacuum thermocouple protected from overvoltage. Up to 1500V dc or rms ac may be applied on any range without damage. A pushbutton protection disable switch allows confirmation that diode aging in protection circuitry is not contributing to error.

Three galvanometer sensitivity settings are provided. A sensitivity test function provides momentary galvanometer deflection for 0.1% and 0.01% of input voltage, at any galvanometer sensitivity setting.

The 540B includes a meter-display search function, for continuous visual indication of input percent of range. The search function indicates when the overload circuit has activated, by deflecting upscale into a red "overload" area. After an overload condition, the 540B is returned to normal operation simply by setting the mode switch to "off."

The basis of transfer comparison in the 540B is always 1:1; ac and dc voltages are placed across the same transfer circuit. In this way, accuracy is independent of range division ratios.

Dc reversal error in the thermocouple is less than 100 ppm (0.01%) of input voltage. A convenient "push-to-reverse" switch is provided to reverse dc input polarity.

A high frequency thermal converter input jack is provided so that the galvanometer and Lindeck reference supply may be used with Fluke Model A55 High Frequency Thermal Converters.

The 540B operates from rechargeable nickel-cadmium battery cells for complete isolation from line power. Fully charged, the 540B may be operated for up to 200 hours without an interruption for charging.

Calibration

Each range is adjusted to be within the specified deviations from zero error as defined by reference standards maintained by the Fluke Standards Laboratory and periodically calibrated by the U.S. National Bureau of Standards. These ac/dc difference figures do not include U.S. National Bureau of Standards' random and systematic errors. Fluke test reports to the nearest 100 ppm are available at extra cost upon request.

Characterization

Model 540B-900 is a 72-point characterization of a new 540B Thermal Transfer Standard. Model 540B-901 is the same characterization service for a customer-owned 540B, available through Fluke Technical Service Centers. All characterizations are actually performed by the John Fluke Standard Laboratory in Everett, Washington. This 72-point characterization is intended to support customers who wish to characterize 5200A ac calibrators as required by 5200A-800 Enhancement Software.

Special characterizations to meet specific calibration requirements are also available. Consult your local Fluke Sales Office for further information.

Specifications

Voltage Ranges: 0.5, 1, 2, 3, 5, 10, 20, 30, 50, 100, 200, 300, 500, and 1000V, with each range usable from ½ to 1 times rating

9V to dV Transfer Uncertainty

Frequency Hz	Voltage Ranges			
	0.5 - 10V	20V - 50V	100V - 500V	1000V
5-20k	±0.01%	±0.01%	±0.01%	±0.02%
20k-50k	±0.01%	±0.01%	±0.01%	±0.04%
50k-100k	±0.05%	±0.05%	±0.20%	X
100k-500k	±0.10%	±0.10%	X	X
500-1M	±0.10%	X	X	X

Search Function: Meter display of input as percentage of range
Input Impedance: 180Ω/V
Polarity: Reversible, front panel push-button
Galvanometer: Fluke electronic type
Galvanometer Resolution: 12 ppm of input/scale division at full range; 60 ppm of input/scale division at half range
Thermocouple Reversal Error: ≤100 ppm of input at full range; ≤300 ppm at half range
Overload Protection: Withstands up to 1500V dc or rms ac, any range
Power: 115V or 230V ac ±10%, 50 to 440 Hz, 7W; self-contained rechargeable batteries; 200 hours operation, 16 hours recharge time
Size: 17.2 cm H x 41.7 cm W x 19 cm D (7 in H x 17 in W x 7.75 in D)
Included: Instruction manual, A55 connecting cable

Model

January 1986 prices

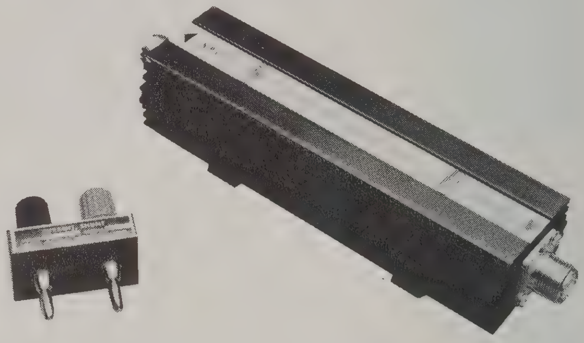
540B Thermal Transfer Standard	$4995

Accessories (Also see page 230)

540B-103 7" Rack Adapter	115
540B-110 Rechargeable Battery Pack (retrofit kit)	410

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



A40/A40A

A40 and A40A Current Shunts

- Ac current transfer measurements from 2.5 mA to 20A
- Frequency response from 5 Hz to 100 kHz
- Designed for use with Model 540B

Models A40 and A40A Current Shunts make possible accurate ac current transfer measurements using the Model 540B Thermal Transfer Standard. Measurements may be made over a 2.5 milliampere to 20 ampere range with a frequency response from 5 Hz to 50 kHz. Measurements to 100 kHz may be made up to 5 amperes.

Twelve A40 current shunts are available with current ratings from 10 milliamperes to 5 amperes. A40A shunts are available with current ratings of 10 and 20 amperes. Each shunt maintains specified accuracy down to half its rated current level. With no shunt in place, the 540B may be used directly for current transfer measurements from 2.5 milliamperes to 5 milliamperes.

A40 shunts plug into panel connectors on the 540B. A40A shunts require special cables, available separately.

Calibration

All aI/dI differences expressed in the specifications are deviations from standards maintained by the U.S. National Bureau of Standards, and may be obtained without the use of calibration curves or correction tables. When properly used with a Fluke 540B Thermal Transfer Standard, each A40 and A40A Current Shunt is within the specified deviation from zero error, as defined by reference standards maintained by the John Fluke Standards Laboratory and periodically calibrated by the U.S. National Bureau of standards. These aI/dI difference figures do not include U.S. National Bureau of standards random and systematic errors. Fluke test reports to the nearest 100 ppm (0.01%) are available at extra cost upon request.

Specifications

A40 Current Ratings: 10, 20, 30, 50, 100, 200, 300, and 500 mA; 1, 2, 3, and 5A
A40A Current Ratings: 10 and 20A

Uncertainty

Frequency	aI/dI Difference	
	A40	A40A
5 Hz - 20 kHz	±0.02%	±0.03%
20 kHz - 50 kHz	±0.03%	±0.05%
50 kHz - 100 kHz	±0.05%	

Model

January 1986 prices

A40* Current Shunts	$495
A40A* Current Shunts	495

**Order by current rating, eg: A40-50 MA. Price is for each shunt*

Accessories

A45-4003 Input Cable for A40A Shunts	65
A45-4004 Output Cable for A40A Shunts	95
Y8133 Test Lead Kit for A40 Shunts	20
C41 Storage Case	595

A55

A55 High Frequency Thermal Converters

- Useable to 50 MHz
- Designed for use with Model 540B

Model A55 Thermal Converters make possible accurate thermal-transfer aV measurements from subaudio frequencies to the VHF region. The design is comparable to that of standards maintained by the U.S. National Bureau of Standards.

Designed for use with the Model 540B Thermal Transfer Standard, nine model A55 Thermal Transfer Standards are available to match each 540B voltage range from 0.5V to 50V. The 540B includes a compatible connector that bypasses its internal transfer circuit, using only the null detector and reference supply. Each A55 converter maintains specified accuracy down to half its rated voltage.

A specially constructed thermocouple, selected for frequency characteristics and low dV reversal error, is the thermally responsive element. Input voltage is applied directly across the thermocouple heater on the 0.5V model. For higher voltages, low temperature-coefficient metal film resistors are used.

Certification

Each A55 converter includes a Fluke production test record of aV/dV differences at 1, 10, 20, and 30 MHz. A55 converters rated below 20V also include a production test record of aV/dV difference at 50 MHz. Fluke test reports at other frequencies and voltages are available at extra cost upon request. AV/dV differences are established to within ±100 ppm by comparison to Fluke standards that are periodically intercompared with the U.S. National Bureau of standards.

Accessory Kit

The Model A55-110 Accessory Kit is recommended for use with A55 Thermal Converters in virtually any calibration or measurement setup. The kit includes:

- Coaxial tee for A55 input (GR type 874-TL).
- Three coaxial adapters for A55 input: UHF, BNC, and type N jack.
- Interconnecting coaxial cable, ac source to coaxial tee.

Specifications

Voltage Ratings: 0.5, 1, 2, 3, 5, 10, 20, 30, and 50V*
**Each converter is useable from ½ to 1 times its rated voltage*

Uncertainty:

Frequency	Calibration Uncertainty*	Typical aV/dV Difference
<1 MHz		<±0.01%
1 MHz	±0.05%	±0.01%
10 MHz	±0.10%	
20 MHz	±0.15%	±0.02%
30 MHz	±0.20%	±0.10%
50 MHz**	±0.50%	±0.30%

**All calibration is referenced to center of GR 874-TL coaxial tee attached to converter input connector*
***50 MHz calibration available only for 0.5, 1, 2, 3, 5, and 10V converters*

Input Impedance: 200Ω/V, approximate
Output Voltage: 7 mV nominal, at rated input
Output Resistance: 8Ω
Reversal Error: <250 ppm (0.025%)
Input Connector: GR type 874-TL
Output Connector: Amphenol 80-PC2M (2-pin microphone)
Size and Weight

Converters	Diameter cm	Length cm	Weight gm
0.5V	3.5	8.4	28
1V, 2V	3.5	13.2	370
3V, 5V	3.5	16.5	430
10V, 20V	3.5	17.9	450
30V, 50V	3.5	17.9	450

Included: Instruction manual and certification (see above)

Model

January 1986 prices

A55* High Frequency Thermal Converter	$595

**Order by voltage rating, eg: A-55 -0.5V. Prices are for each converter*

Accessories (Also see page 230)

A55-110 Accessory Kit	595
C55 Storage Case	595

COMPUTER-AIDED CALIBRATION

Introduction

Why Computer-Aided Calibration?

Calibration labs today are more than ever being caught in the perennial problem of needing to do more, in less time, with less money, and fewer people. Calibration workloads are increasing yet trained technicians are getting harder to find. Cal lab managers are constantly seeking new ways to relieve these problems.

Fortunately, cal labs do have the option of turning to computer-aided calibration. A computer or instrument controller aids calibration by controlling the calibration instruments via an IEEE-488 bus and by giving operator instructions via menu driven prompts. A good computer-aided calibration system is traceable to national standards, can be used in local area networks, can control the unit under test (UUT), and record calibration results automatically.

Computer-Aided Calibration Gives Needed Relief

Computer-aided calibration minimizes the need to have highly trained technicians perform repetitive calibration tasks. Instead, people with limited calibration background produce useful results with short learning curves. Your skilled technicians can be saved for more complicated tasks like repair and troubleshooting.

Quality of calibration is also improved through automation. Since the computer guides calibration, repeatability of calibration events is ensured — a critical factor in a time of stricter calibration regulations.

Get Control of Your Time and Your Calibration

How do you know if you would benefit from computer-aided calibration? If you see your workload getting out of control, that is a good indication. Or, if you see a need for more people and are having trouble finding skilled people, that is another indication. You may also need computer-aided calibration if you are facing increasing regulations and a need for greater documentation.

If your lab performs verification checks prior to adjusting the UUT, you will especially benefit from computer-aided calibration because it provides greatly increased throughput. Computer-aided calibration also helps an operator adjust older UUTs faster, while fully automating the adjustment of the new generation of software calibrated UUTs.

Computer-Aided Calibration For Every Need

In the following pages you will find a variety of automated solutions to your calibration needs. From computer-aided calibration clusters to the world's most accurate automated calibration workstations, Fluke brings a fresh approach to calibration.

Fluke Computer-Aided Calibration Selection Guide

Building Blocks for Computer-Aided Calibration		Applications Summary							
		Computer-Aided Bench-Top Clusters			Automated Calibration Workstations				
		Do-It-Yourself	7404B	7449A	7405A	7410A	A123-CO	A123-PE	Custom
Model	**Description**	**Page 131**	**Page 133**	**Page 136**	**Page 138**	**Page 140**	**Page 144**	**Page 144**	**Page 144**
7411A	Calibration Software	#	#	#	#	#	#	#	#
1722A	Instrument Controller	#	#	#	#	#	#	#	#
7422A	Combined 7411A and 1722A	●	—	—	—	—	—	—	—
5200B	Multifunction Calibrator	●	#	#	#	—	#	#	●
5200A	Precision 6-Digit aV Calibrator	●	—	—	—	—	—	#	●
5205A	Precision Power Amplifier	●	●	●	●	—	●	●	●
5215A	Precision Power Amplifier	●	—	—	—	—	—	—	●
5220A	Transconductance Amplifier	●	●	●	●	—	●	●	●
5440B	Precision Direct Voltage Calibrator	●	—	—	●	—	#	#	●
5450A	Resistance Calibrator (1Ω-100M)	●	—	—	●	—	#	#	●
CG5001	Oscilloscope Calibrator (Tektronix®)	●	—	#	—	#	●	●	●
1953A	Frequency Counter/Timer	●	—	—	●	—	—	—	●
6011A	Signal Generator (10 Hz-11 MHz)	●	—	—	—	●	—	—	●
6060B	Signal Generator (400 kHz-1.05 GHz)	●	—	—	—	●	●	●	●
6070A	Signal Generator (200 kHz-520 MHz)	●	—	—	—	●	—	—	●
6071A	Signal Generator (200 kHz-1.04 GHz)	●	—	—	—	●	—	—	●
8505A	Digital Multimeter	●	—	—	#	—	—	—	●
8506A	Digital Multimeter	●	#	#	—	—	#	#	●
8520A	Digital Multimeter	●	—	—	—	#	—	—	
	Test Interface Panel	—	—	—	#	#	#	#	●
	Rack	—	●	●	#	#	#	#	#
Calibration Capabilities:									
	Analog and Digital to 4½-Digit Meters	#	#	#	#	—	#	#	#
	Analog and Digital to 5½-Digit Meters	#	#	#	—	—	#	#	#
	Analog and Digital to 7½-Digit Meters	#	—	—	—	—	#	#	#
	Oscilloscopes	#	—	#	—	#	●	●	●
	Mobile Calibration	#	#	#	—	—	●	●	●

# Standard ● Optional

Computer-Aided Calibration Clusters — Using Fluke Calibration Software, Controllers & Instruments

- Calibration-at-a-Keystroke software
- User configurable
- Automation of both meter and oscilloscope calibration
- Automated ease with benchtop convenience
- Enables accurate, repeatable calibration tests
- Complete results and calibration data management
- Allows efficient use of technical personnel

Computer-Aided Calibration Clusters are automated combinations of calibration instruments controlled by the IEEE-488 bus. Thanks to Fluke 7411A Calibration-at-a-Keystroke software, you can define the instruments you want to automate. Consult the chart on page to select the instruments you would like to automate. Then use Fluke 7411A Calibration-at-a-Keystroke software to transform the instruments from stand-alone manual mode, to full automation under the control of the Fluke 1722A Instrument Controller.

Your computer-aided calibration cluster will give you all the benefits of automated calibration — ease of use, cautomatic data recording, and reduced cost per calibration.

The Best of Both Worlds

Calibration instruments have two modes of operation: local (operated manually) and remote (automated control). Manual control gives you direct access to the instrument controls. Automated control lets the computer do the work. Fluke computer-aided calibration clusters give you the best of both worlds.

Fluke 7411A Calibration-at-a-Keystroke software guides you through automated calibration procedures. These procedures control your instruments in performing accurate calibrations of your test equipment. Instructions to the operator are presented on the 1722A screen. Any responses from the operator are made through the convenient, touch-sensitive screen.

Computer-aided calibration clusters also give you easy, direct access to your instruments for single tests. But automation of your benchtop cluster gives you added benefits stand-alone instruments cannot give.

Since the controller instructs the operator during each calibration, operators with less experience can perform calibration effectively. This is critical today when experienced technicians are getting hard to find.

Automated calibration is based on standard procedures you tailor to fit your calibration philosophy. These computer-aided procedures guarantee repeatability of your calibration tests — a feature absolutely necessary to satisfy stiffening government requirements. Plus, your system will record complete calibration results. You no longer need to spend time hand recording data.

Fluke Model 7404B For Calibrating 5½ Digit Meters

The Fluke 7404B is a computer-aided calibration cluster of instruments that automatically directs a Fluke 8506A DMM to measure the aV and dV outputs of the Fluke 500B and, under program control, enhance their accuracy to 13 ppm for dV and 190 ppm for midband aV. These accuracies are sufficient to calibrate most models of 5½ digit DMMs. See page for a complete description of the 7404B.

Fluke Model 7449A For Calibrating Meters and Oscilloscopes

Fluke Model 7449A adds a Tektronix CG5001 Oscilloscope Calibrator to the 7404B to provide all of the 7404B meter calibration features plus the oscilloscope calibration capability of the CG5001. The 7449A is available as a complete package from Fluke or its constituent elements can be ordered from Fluke and Tektronix. The 7449A is described on page

Standard or Special Automated Calibration Workstations

Fluke also provides complete automated calibration workstations to fill state-of-the-art calibration requirements. A computer-aided calibration cluster is upwardly compatible with expansion into an automated calibration workstation.

Our automated calibration workstations give you fully integrated, automated calibration with the benefits of convenient test interface panels. You get fully configured, computer-aided calibration software, the instruments of your choice from the Computer-Aided Calibration Selection Guide, and full rack integration. These workstations include instrument configurations demanded by metrologists around the world.

Fluke offers both standard and special automated calibration workstations for meters or oscilloscopes. Standard workstations are configured at Fluke to maximize the system capabilities of the integrated instruments. Standard workstations include the 7405A and 7410A. The Fluke 7405A is a fully configured automated meter calibration workstation. The Fluke 7410A is an automated oscilloscope calibration workstation. These workstations are discussed in greater detail in the following pages.

Fluke will also configure special workstations to fit your own particular needs. From combined meter/oscilloscope workstations, to mobile calibration workstations, to the world's most accurate meter calibration workstation, Fluke offers what you need to do your job. The instruments available with these workstations are covered in the Computer-Aided Calibration Selection Guide.

Configuring Your Own 7411A-Based Computer-Aided Calibration System

Fluke 7411-based Computer-Aided Calibration Systems are easy to configure. Determine your calibration requirements. If a standard Fluke computer-aided calibration system does not fit your exact application and situation, select the instruments you need to integrate from the guide on page . You may already have some of these instruments in your lab or you can purchase them new.

New look at the description of the Fluke 7411A Calibration-at-a-Keystroke Software and 7422A Control and Software Package. Depending on what calibration instruments you own, one of these product packages will serve your needs for integration, software, and control. Your Fluke Sales Engineer can also provide assistance.

Standard or Special Automated Calibration Workstations

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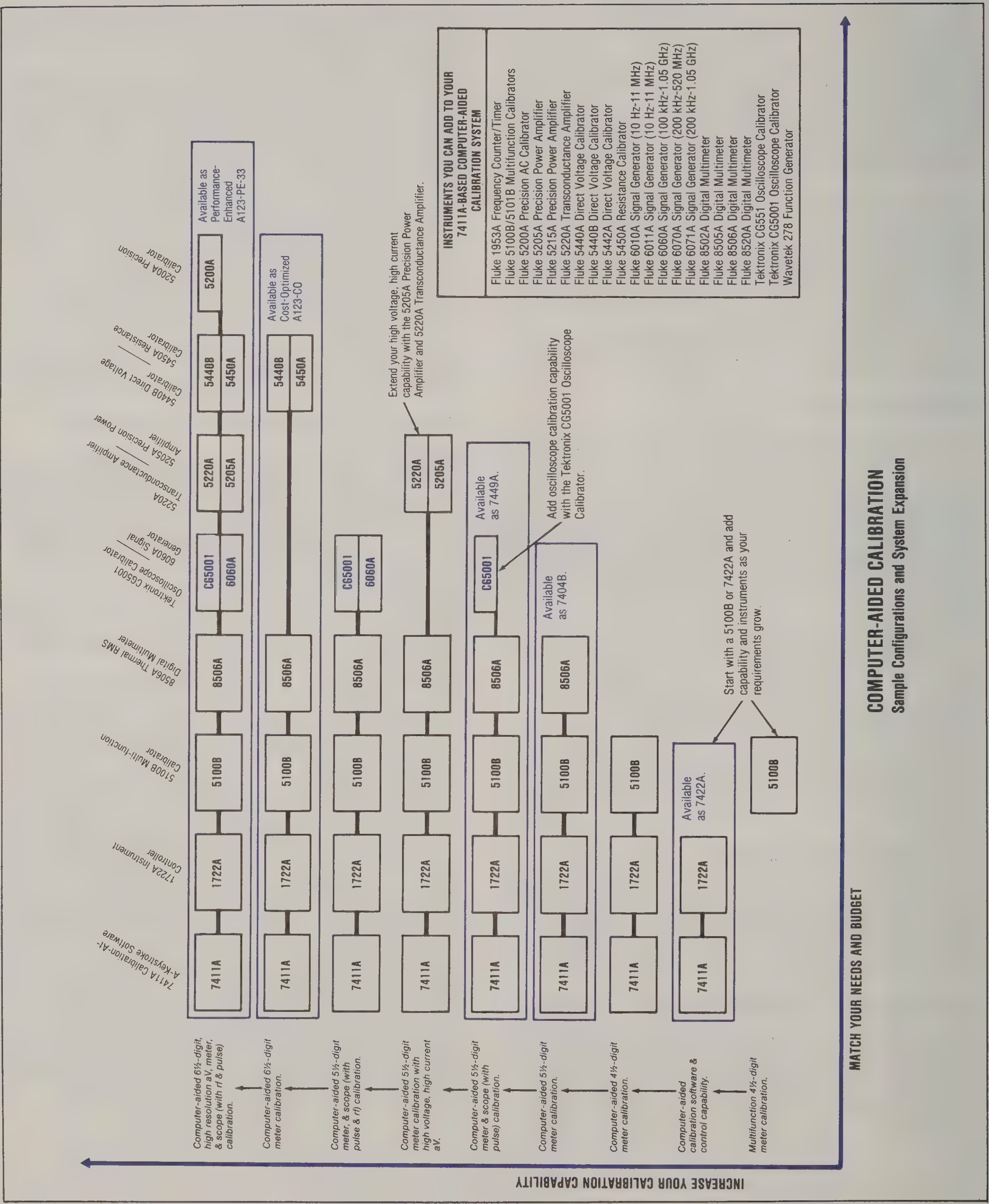
COMPUTER-AIDED BENCHTOP CLUSTERS

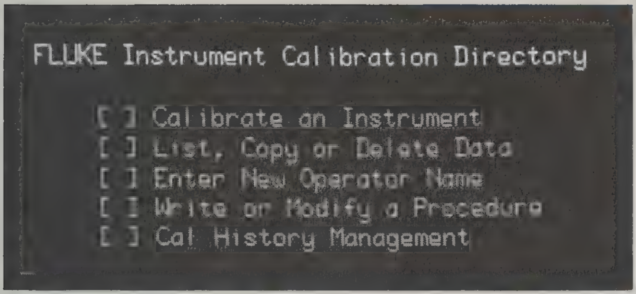
Graph of Increasing Capability With Fluke 7411A Computer Aided Benchtop Clusters


7411A Calibration-At-A-Keystroke Software
1722A Instrument Controller
5100B Multi-function Calibrator
8506A Thermal RMS Digital Multimeter
Tektronix CG5001 Oscilloscope Calibrator
6060A Signal Generator
5220A Transconductance Amplifier
5205A Precision Power Amplifier
5440B Direct Voltage Calibrator
5450A Resistance Calibrator
5200A Precision Calibrator
7411A
1722A
5100B
8506A
CG5001
6060A
5220A
5205A
5440B
5450A
5200A
Available as Performance-Enhanced A123-PE-33
Available as Cost-Optimized A123-CO
Extend your high voltage, high current capability with the 5205A Precision Power Amplifier and 5220A Transconductance Amplifier.
Available as 7449A.
Add oscilloscope calibration capability with the Tektronix CG5001 Oscilloscope Calibrator.
Available as 7404B.
Available as 7422A.
Start with a 5100B or 7422A and add capability and instruments as your requirements grow.
Computer-aided 6½-digit, high resolution aV, meter, & scope (with rf & pulse) calibration.
Computer-aided 6½-digit meter calibration.
Computer-aided 5½-digit meter, & scope (with pulse & rf) calibration.
Computer-aided 5½-digit meter calibration with high voltage, high current aV.
Computer-aided 5½-digit meter & scope (with pulse) calibration.
Computer-aided 5½-digit meter calibration.
Computer-aided 4½-digit meter calibration.
Computer-aided calibration software & control capability.
Multifunction 4½-digit meter calibration.
INCREASE YOUR CALIBRATION CAPABILITY
MATCH YOUR NEEDS AND BUDGET
COMPUTER-AIDED CALIBRATION
Sample Configurations and System Expansion

INSTRUMENTS YOU CAN ADD TO YOUR 7411A-BASED COMPUTER-AIDED CALIBRATION SYSTEM

- Fluke 1953A Frequency Counter/Timer
- Fluke 5100B/5101B Multifunction Calibrators
- Fluke 5200A Precision AC Calibrator
- Fluke 5205A Precision Power Amplifier
- Fluke 5215A Precision Power Amplifier
- Fluke 5220A Transconductance Amplifier
- Fluke 5440A Direct Voltage Calibrator
- Fluke 5440B Direct Voltage Calibrator
- Fluke 5442A Direct Voltage Calibrator
- Fluke 5450A Resistance Calibrator
- Fluke 6010A Signal Generator (10 Hz-11 MHz)
- Fluke 6011A Signal Generator (10 Hz-11 MHz)
- Fluke 6060A Signal Generator (100 kHz-1.05 GHz)
- Fluke 6070A Signal Generator (200 kHz-520 MHz)
- Fluke 6071A Signal Generator (200 kHz-1.05 GHz)
- Fluke 8502A Digital Multimeter
- Fluke 8505A Digital Multimeter
- Fluke 8506A Digital Multimeter
- Fluke 8520A Digital Multimeter
- Tektronix CG551 Oscilloscope Calibrator
- Tektronix CG5001 Oscilloscope Calibrator
- Wavetek 278 Function Generator

7411A Calibration-at-a-Keystroke Software
7422A Control and Software Package



```
FLUKE Instrument Calibration Directory

     [ ] Calibrate an Instrument
     [ ] List, Copy or Delete Data
     [ ] Enter New Operator Name
     [ ] Write or Modify a Procedure
     [ ] Cal History Management
```

7411A Calibration-at-a-Keystroke Software
7422A Control and Software Package

- Save time and money on your calibration process while protecting your past and future investments
- Provided with Fluke 7404B, 7449A, 7405A, 7410A, 7422A, and A123-Series Calibration Systems
- Includes numerous meter and oscilloscope calibration procedures

Fluke 7411A Calibration-at-a-Keystroke Software is a comprehensive approach to automating the calibration process, based on over thirty years experience in calibration, Fluke recognizes the needs of calibration laboratories and these needs are met with the 7411A. 7411A Calibration Software allows you to generate calibration and verification procedures, to run these procedures so your instruments are reliably and quickly calibrated, to obtain results listings of the calibration procedure, and to automate your record keeping and traceability requirements with data management software that generates calibration history reports.

7411A Calibration Software gives you the capability to calibrate most meters and oscilloscopes, and some power supplies, frequency counters, and instrumentation amplifiers. The software runs on the Fluke 1722A Instrument Controller, a controller specifically designed for instrument control in the test and measurement environment. The 1722A makes operator interaction simple, using a touch sensitive display. The operator can control the system by pressing the 1722A's display or via a handheld Operator's Aid; a keyboard is only necessary while writing procedures.

The 7411A also comes with a library of calibration procedures. Use these procedures for meters and scopes of major manufacturers, modify the procedures to fit your philosophy, or write your own custom procedures.

Field-proven, 7411A Calibration Software contains all the power and features of Fluke's computer-aided calibration systems, including the 7404A, 7404B, 7449A, 7405A, 7410A, and A123-Series calibration systems. These systems represent the finest in both meter and scope calibration; their unmatched capabilities have been embodied in the 7411A.

7411A Calibration Software is a must for any cal lab that is seriously considering automation, allowing you to implement complete "hands-off" closed-loop calibration of IEEE-488 meters.

Simple and Easy to Use for All Levels of Personnel

All levels of personnel in your lab will find 7411A Calibration Software easy to use. Your procedure writer does not need to know how to program computers in order to write 7411A procedures. With little start-up time, a procedure writer familiar with the techniques of calibration and the philosophy of your lab can quickly begin writing procedures. The software prompts the procedure writer for the required calibration data such as messages to the operator, nominal value and tolerance of the stimulus, and where appropriate, IEEE-488 bus commands for the unit under test (UUT). A number of error checking features are provided that reject procedural data incompatible with the capabilities of the system being controlled by the 7411A. For example, the software won't allow a procedure to ask for a stimulus that would supply a greater level of output than the stimulus instrument is able to put out. Complete error messages are also provided.

The non-technical operator of your 7411A-based automated calibration system will find the software easy to learn and work with. The operator cannot modify or skip events, or otherwise change the sequence except as permitted in the procedure by the procedure writer. The main menu prompts the operator to choose what is to be done by pressing the touch sensitive display. The procedure combines messages with graphics to help the operator complete each test. Touch the display once to make the UUT read a voltage; touch it again to automatically evaluate the UUT's reading. Under control of the test procedures, the results of each test can be displayed. When a procedure is finished, the operator chooses to print the results, save them on diskette, or archive them remotely — or all three functions can be done. And your investment in procedures is secure. Any future, improved versions of the 7411A will execute the procedures you write today.

The Calibration History Management feature of the 7411A makes managing your system simple. Create and generate reports, save all test results, or summarize results data. Recall reports will help you forecast what instruments are due for calibration, or create an inventory report listing all instruments belonging to a particular department. If you need to determine how a particular instrument model has been performing, a report can list how many times it has failed verification. The format for each report is created only once.

7422A Control and Software Package

If a 7404B, 7449A, or other standard Fluke computer-aided calibration system isn't suitable for a particular application or situation, the Fluke 7422A Control and Software Package can be used to configure a customized general purpose test or calibration system. The 7422A consists of a 1722A Instrument Controller (with 512K-byte Expansion Memory, Option -007, and IEEE-488/RS-232-C interface, Option -008), 7411A Calibration Software, an Operator's Aid, and a shielded IEEE-488 bus cable. This gives you the power of the 7411A Calibration-at-a-Keystroke Software under the control of the 1722A. Simply add your existing instruments and you are ready to start.

Specifications

Mainframe Instruments Controlled by 7411A Calibration Software

Fluke 1722A Instrument Controller
Fluke 1953A Universal Counter/Timer
Fluke 5100 Series B Multifunction Calibrators (5100B, 5101B, 5102B)
Fluke 5205A Precision Power Amplifier
Fluke 5215A Precision Power Amplifier
Fluke 5200A AC Calibrator
Fluke 5220A Transconductance Amplifier
Fluke 5440 Series Direct Voltage Calibrators (5440A, 5440B, 5442A)
Fluke 5450A Resistance Calibrator
Fluke 6010A Synthesized Signal Generator
Fluke 6011A Synthesized Signal Generator
Fluke 6060A Synthesized Signal Generator
Fluke 6070A Synthesized Signal Generator
Fluke 6071A Synthesized Signal Generator
Fluke 8502A Digital Multimeter
Fluke 8505A Digital Multimeter
Fluke 8506A Digital Multimeter
Fluke 8520A Digital Multimeter
Tektronix CG551 Oscilloscope Calibrator
Tektronix CG5001 Oscilloscope Calibrator
Wavetek 278 Function Generator

Types of Instruments Tested

Measurement and stimulus instruments ranging from direct voltage to 1 GHz, either manually or via an IEEE-488 interface. By using the IEEE-488 interface instruments can be closed-loop, closed case tested with little or no operator interaction during the test procedure.

Major Capabilities

Write or modify a procedure.
Calibrate and/or verify an instrument.
Calibration History Management.
List results and data.

7411A Calibration-at-a-Keystroke Software
7422A Control and Software Package

Calibration Modes

Performance Verification: In this mode the performance of the UUT is checked and the results recorded. No adjustments are permitted.
Calibration With Adjustment: In this mode the performance of the UUT is checked, its calibration adjusted, and the results are recorded.

Other Utilities

The following are other functions included within the 7411A Calibration Software.
Recording Results: Test procedure results can be recorded via a printer as described under List, Copy, and Delete Data.
List, Copy, or Delete Data: Possible data includes procedures and test results.
List: Procedures, results, and diskette catalogs can be displayed on the 1722A or be listed to a RS-232-C Printer. All or selected portions of procedures or results can be listed or displayed.
Copy: Procedures and results can be copied from disk to disk, and to or from remote devices such as another computer in a Local Area Network (LAN).
Enter New Operator Name: A system operator uses this utility to enter his or her name for use in the header of the results display or print-out. The name on the print-out is the last name entered.

Calibration History Management

This is a data management utility for manipulating results data to create user-defined reports. It allows the user to define, modify, or create a report, using the data fields in the test results files. Typical data may include a UUT's serial number, operator's name, calibration time (elapsed and chronological), and other such data.

Function Selection Codes (FSCs)

FSCs are the mnemonics of the 7411A procedure language, controlling the function of your 7411A-based system. Procedures are made up of a series of FSCs, arranged according to the needs of the calibration procedure and, therefore, the procedure writer.

Programmers with BASIC programming experience can add FSCs for new instruments via the 7411A source code or access the 1722A's BASIC to allow the 7411A-based system to communicate with almost any IEEE-488 instrument.

**All mainframe instruments require an IEEE-488 interface. See the 7411A Calibration-at-a-Keystroke Data Sheet for information on 7411A support of instrument options; e.g., the 7411A supports the 5100 Series B wideband option.*

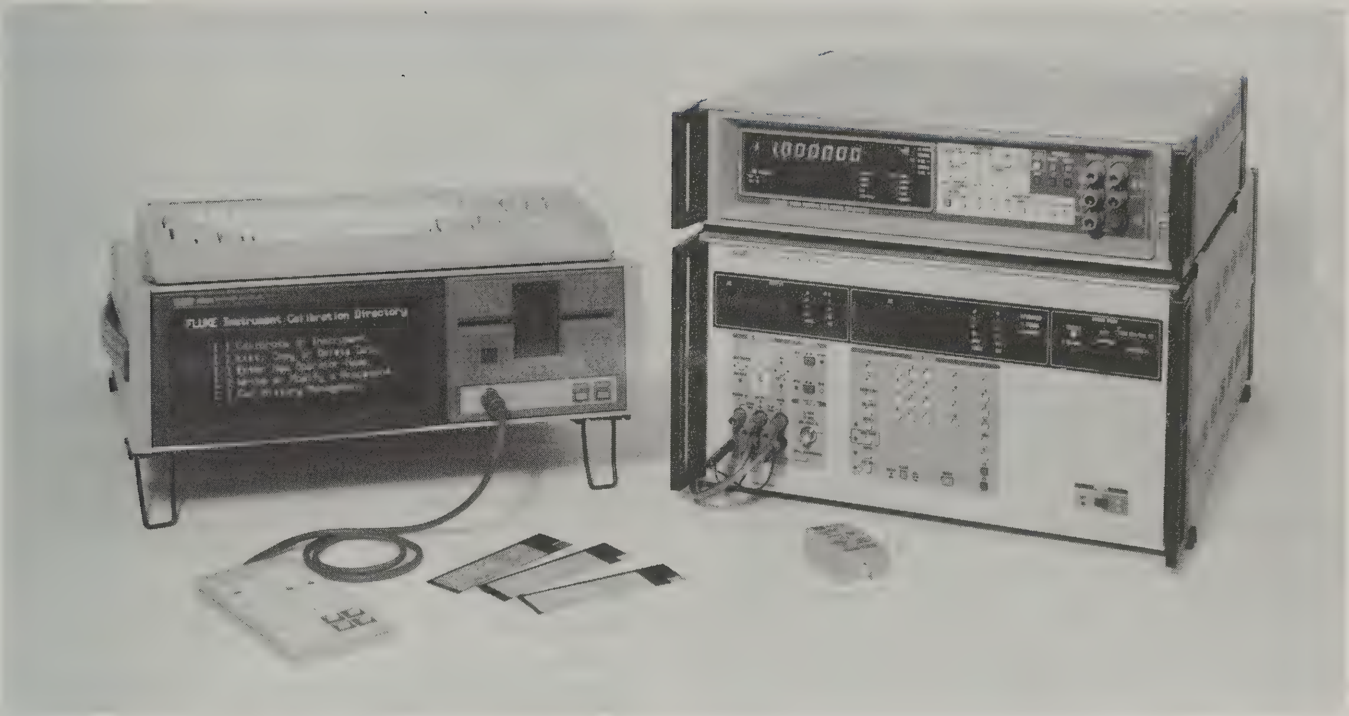
Ordering Information

The following lists ordering information for 7411A Calibration-at-a-Keystroke Software and 7422A Control and Software Package. For further configuration information see the 7411A Calibration-at-a-Keystroke Data Sheet, available from your Fluke Sales Engineer or by calling Fluke at one of the phone numbers at the back of this catalog.

Model	January 1986 prices
7411A Calibration-at-a-Keystroke Software including:	$1195
Procedure Generation Software	
Instrument Calibration Software	
Calibration History Management Software	
Fluke-certified calibration procedures	
User Group procedures	
7411A Manual Set	
7422A Control and Software Package including:	10,120
7411A Calibration Software	
1722A Instrument Controller (including IEEE-488/RS-232-C interface, Option -008 and 512K-byte RAM, Option -007)	
Operator's Aid	
Y8021 1m IEEE-488 cable	
7411A Manual Set	
1722A Manual Set	
7411A-100 7411A Source Code	5000
7411A-600 Additional 7411A Manual Set including:	100
Getting Started Guide	
Operator Manual	
Procedure Writing Manual	
Procedure Writing Quick Reference Guide	

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



7404B

7404B Computer-Aided Benchtop Cluster

- Saves you time and money from the day of installation
- Protects your past and future investments
- 5½-digit meter calibration
- 7411A Calibration-At-A-Keystroke Software included
- Closed-loop calibration procedures included

The 7404B Computer-Aided Calibration Cluster is an automated, highly accurate meter calibration system. It allows you to quickly and accurately calibrate digital and analog meters, power supplies, and other electronic instruments. The 7404B combines field-proven Fluke hardware and state-of-the-art 7411A Calibration Software in a system designed for reliability, durability, and performance that will meet your most stringent demands. Hardware combines the Fluke 5100B Multifunction Calibrator and 8506A Digital Multimeter under the control of the 1722A Instrument Controller; the 1722A runs the 7411A Calibration Software.

The 7404A will save you time and money as soon as it is installed. (And installation is easy, requiring you only to connect the IEEE-488 cables and power cords in benchtop configurations.) A library of user group procedures is included, covering most common DMMs. User-friendly software prompts even your least trained technicians through procedures quickly and easily. You are not required to invest time in writing procedures or extensive training.

The 7404B protects your past investment by incorporating Fluke instruments you already own; your future investment is protected too by the 7411A Calibration Software. You can upgrade your 7404B as your needs grow without making additional software investments. 7411A Calibration Software is comprehensive, with built-in capability to integrate additional instruments into your 7404B Calibration Cluster without the requirement that you buy additional software packages.

Field-Proven Fluke Hardware and Software

The 5100B Multifunction Calibrator, the world's best-selling calibrator and heart of the 7404B, gives you six function capability in a single instrument. Functions include direct and alternating voltage, direct and alternating current, resistance, and rf. These sources (except rf) are available from a single output, simplifying the closed-loop calibration of DMMs. You don't need to spend time moving connections and switching a test interface panel.

The synergistic design of the 7404B gives you "accuracy enhancement." The 7404B uses the inherent accuracy of the 8506A Digital Multimeter to increase the accuracy of the 5100B, giving you more precise calibrations. Thanks to this accurcy enhancement, the 7404B gives you a best direct voltage stimulus uncertainty of 13 ppm and alternating voltage stimulus to 190 ppm. this enhancement process is accomplished automatically via software, rather than manually by the operator.

The 1722A Instrument Controller which automates the 7404B, is a true instrument controller designed specifically for instrument control in the test and measurement environment.

Fluke has concentrated on designing an easy to use and convenient operator interface. While using the 7404B, you can interact with the system via the 1722A's Touch-Sense Display which displays instructions and options for obvious actions, or use the handheld operator keypad. A full ASCII keyboard is only used for writing or editing procedures and can be removed when it is not needed.

Upgrade Your Existing Fluke Instruments To A 7404B.

If you already own a Fluke 5100B, 5101B, or 8506A you can add the power of the 1722A Instrument Controller and 7411A Calibration Software to create your own 7404B. Complete packages are available that simplify the process of ordering upgrade hardware and software. Compare your existing equipment with Standard 7404B Components listed below and note the items you do not have. Then order only those items that you need to complete your upgrade from the Standard 7404B Component list or, if convenient, order a complete upgrade package from the Standard Upgrade Packages list.

7404B

Standard 7404B Components

The standard 7404B consists of the following major items:

- Fluke 5100B Multifunction Calibrator with a 5100A-05 IEEE-488 interface option.
- Fluke 8506A Digital Multimeter with an 8500A-05 IEEE-488 interface option.
- Fluke 1722A Instrument Controller with a 17XXA-007 512K-byte RAM option.
- Fluke 7404B-800 User Interface/Accessories Package that contains:
  7411A Calibration-At-A-Keystroke Software with manuals.
  7400A-997 Operator's Aid, a small handheld keypad the operator uses in conjunction with the 1722A Touch-Sense display to control the 7404B.
  7405A-4207 AC Divider, a small ac divider used to reduce the alternating voltage output of the 5100B to the millivolt level when calibrating wideband rf voltmeters at low frequencies.
  Y8021 (3 each) Shielded one meter IEEE-488 bus cables.
  Y8404 Analog Accuracy Enhancement Cable, used to connect the 5100B voltage outputs to the 8506A's rear input.

7411A Software Is Ready When You Expand Your 7404B

The 7411A Calibration Software provided with the 7404B is fully compatible with expansion of the 7404B's capabilities. The 7411A supports the addition of the 5205A or 5215A Precision Power Amplifiers and 5220A Transconductance Amplifier. It also supports the addition of other calibrators such as the 5440B Direct Voltage Calibrator or 5450A Resistance Calibrator to the calibration cluster. The 7404B can also be upgraded to a 7449A Oscilloscope Calibration Cluster by adding the 7410A-400 Oscilloscope Calibration option. A printer for generating hard copy of calibration constants and test results can also be added. Your Fluke Sales Engineer will have the information you need.

Take Calibration To The Production Floor

Take your 7404B Computer-Aided Calibration Cluster to the production floor to calibrate your instruments in place with the 7404B/R which includes a mobile rack. On-site calibration means no time lost due to instruments in the pipeline waiting for calibration. This results in less downtime for your systems, more use from your instruments, and fewer instruments required as back-ups. The 7404B/R gives you a sturdy mobile rack with a convenient controller mounting tray for operator ease and a work surface for your instruments under test. There's additional room in the rack for another instrument of your choice.

Specifications[1] (90 Days, 23°C ±5°C)

Direct Volts, Enhanced Mode: (% of Output + Microvolts)

Output Voltage	Uncertainty
0 mV - 200 mV	0.0022 + 1.6
200 mV - 2V	0.0014 + 6.2
2V - 20V	0.001 + 60
20V - 200V	0.0017 + 600
200V - 1100V	0.0017 + 6 mV

Direct Volts, Unenhanced Mode (180 Days, 23°C ±5°C): ±(0.005% of output + 0.001% of range + 5μV)
Direct Current: ±(0.015% of Output + 0.002% of Range + 0.01 μA)
Alternating Current: ±(0.05% of Output + 0.005% of Range + 0.02 μA)

Resistance: (% of Output)

Ohms	Uncertainty	Ohms	Uncertainty
1	0.015	10K	0.003
10	0.010	100K	0.003
100	0.003	1M	0.010
1K	0.003	10M	0.030

Measurement Specifications[2]

AC RMS Voltage Measurement; Accuracy: High Accuracy Mode: ±(% of Reading + Number of Counts)

	Frequency in Hertz						
	24 Hours: 23°C ±1°C[3]						
Range	**10 to 40[5]**	**40 to 20k**	**20k to 50k**	**50k to 100k**	**100k to 200k**	**200k to 500k**	**500k to 1M**
100 mV	0.08 + 0	0.02 + 5	0.04 + 5	0.2 + 0	0.6 + 0	1.5 + 0	3.5 + 0
300 mV to 10V	0.08 + 0	0.012 + 0	0.04 + 0	0.2 + 0	0.5 + 0	1.5 + 0	3.5 + 0
30V	0.08 + 0	0.012 + 0	0.04 + 0	0.2 + 0	0.5 + 0	3.5 + 0	12 + 0
100V	0.08 + 0	0.012 + 0	0.04 + 0	0.2 + 0	1.0 + 0	3.5 + 0	—
500V[4]	0.08 + 0	0.012 + 0	0.04 + 0	0.2 + 0	—	—	—
	90 Days: 23°C ±5°C						
100 mV	0.08 + 0	0.026 + 5	0.06 + 5	0.2 + 0	0.6 + 0	1.5 + 0	3.5 + 0
300 mV to 10V	0.08 + 0	0.016 + 0	0.06 + 0	0.2 + 0	0.5 + 0	1.5 + 0	3.5 + 0
30V	0.08 + 0	0.016 + 0	0.06 + 0	0.2 + 0	0.5 + 0	3.5 + 0	12 + 0
100V	0.08 + 0	0.016 + 0	0.06 + 0	0.2 + 0	1.0 + 0	3.5 + 0	—
500V[4]	0.08 + 0	0.016 + 0	0.06 + 0	0.2 + 0	—	—	—

DC Voltage Measurement; Accuracy: ±(% of Reading + Number of Counts)

Range	24 Hour[3] 23°C ±1°C		90 Days 23°C ±5°C		>23°C ±5°C Add to the 90 day specification per month	
	Operating Mode		Operating Mode		Operating Mode	
	Norm	Avg	Norm	Avg[6]	Norm	Avg[6]
100 mV	0.0018 + 15	0.0010 + 8	0.0025 + 40	0.0020 + 8	0.00017 + 5.6	0.0001 + 0.1
1V	0.0008 + 75	0.0005 + 4	0.0015 + 8	0.0012 + 6	0.0001 + 0.1	0.0001 + 1[4]
10V	0.0006 or 6[7]	0.0005 or 50[7,8]	0.0010 + 8	0.0008 + 60[8]	0.0001 + 0.1	0.00008 + 1[8]
100V	0.0010 + 6	0.0005 + 5	0.0018 + 8	0.0015 + 6	0.00013 + 0.1	0.0001 + 0.1
100V	0.0010 + 6	0.0005 + 5	0.0018 + 8	0.0015 + 6	0.00013 + 0.1	0.0001 + 0.1
1000V	0.0008 + 6	0.0005 + 5	0.0018 + 8	0.0015 + 6	0.00013 + 0.1	0.0001 + 0.1

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[1] *Specifications not listed herein are the same as for 5100Band 8506A and can be found on those data sheets. Maximum Capacitive Load for enhanced Direct and Alternating Volts is 350 pF.*

[2] *For further information, consult 8506A Data Sheet.*

[3] *Relative to calibration standards, 4 hour warm-up, within 1 hour of dc zero. After software calibration, add the following to the 24 hour accuracy specification:*

Time Since Internal (Hardware) Calibration	Number of Counts[9]
<30 Days	0
<90 Days	1
<1 Year	2
⩾1 Year	3

[4] *Add voltage coefficient per 8506 Data Sheet.*
[5] *With slow filter.*
[6] *After 4 hour warm-up, within 1 hour of dc zero.*
[7] *Whichever is greater.*
[8] *7½-digit mode of operation.*
[9] *With 6½-digit display. For 7½-digits, multiply Number of Counts by 10.*

Alternating Volts, Enhanced Mode: (% of Output + Floor)

Range	Frequency		
	50 Hz-1 kHz	50 Hz-20 kHz	20 kHz-50 kHz
1 mV-12.5 mV	55 μV	55 μV	60 μV
12.5 mV-125 mV	0.30 + 7 μV	0.30 + 7 μV	0.065 + 10 μV
125 mV-200 mV	0.018 + 2 μV	0.018 + 2 μV	0.065 + 2 μV
0.2V-2V	0.018 + 20 μV	0.018 + 20 μV	0.065 + 20 μV
2V-20V	0.018 + 200 μV	0.018 + 200 μV	0.065 + 200 μV
20V-110V	0.018 + 2000 μV	0.018 + 2000 μV	
110V-125V	0.018 + 2 mV		
125V-200V	0.030 + 2 mV		
200V-600V	0.030 + 10 mV		
600V-1100V	0.050 + 50 mV		

Wideband frequencies with 5100B-03 Option are quoted on 5100B Data Sheet

Alternating Volts, Unenhanced Mode (180 Days, 20°C to 30°C): 50 Hz to 10 kHz, ±(0.05% of output + 0.005% of range +50 μV); 10 kHz to 50 kHz, ±(0.08% of output + 0.008% of range +50 μV)

Ordering Information

The following information applies to the 7404B. Ordering information for a 7449A Oscilloscope Calibration cluster is found on page

Model

January 1986 prices

7404B Computer-Aided Meter Calibration Cluster	$29,950

Options

7404A-970 5100B w/-03 and -05 Options	14,310
7400A-506 8506A w/-05 Option	6960
7400A-993 1722A w/-007 and -008 Options	8390
7404B-800 User Interface/Accessories Package	2475
5100A-05 IEEE-488 Interface for 5100B or 5101B	610
8500A-05 IEEE-488 Interface for 8506A	530
1722A-007 512K-byte RAM Expansion for 1722A	2250
1722A-008 IEEE-488/RS232C Interface for 1722A	590
7400A-700 Procedure Writing Training	760

Accessories (Also see page 230)

Y5000 Boost Interface for for 5100B (one Y5000 supports both voltage and current boost)	555
Y5001 Boost Cable for 5205A or 5215A	250
Y5002 Boost Cable for 5220A	225
5205A Precision Power Amplifier for aV and dV (requires Y5000 and Y5002 in 5100B)	8950
5215A Precision Power Amplifier for aV (requires Y5000 and Y5002 in 5100B)	8290
5220A Transconductance Amplifier (requires Y5000 and Y5001 in 5100B)	4795
5440B Direct Voltage Calibrator	12,950
5450B Resistance Calibrator	3995
Y8021 1m Shielded Cable, for IEEE-488 bus	85
Y8022 2m Shielded Cable, for IEEE-488 bus	95
Y8023 4m Shielded Cable, for IEEE-488 bus	105

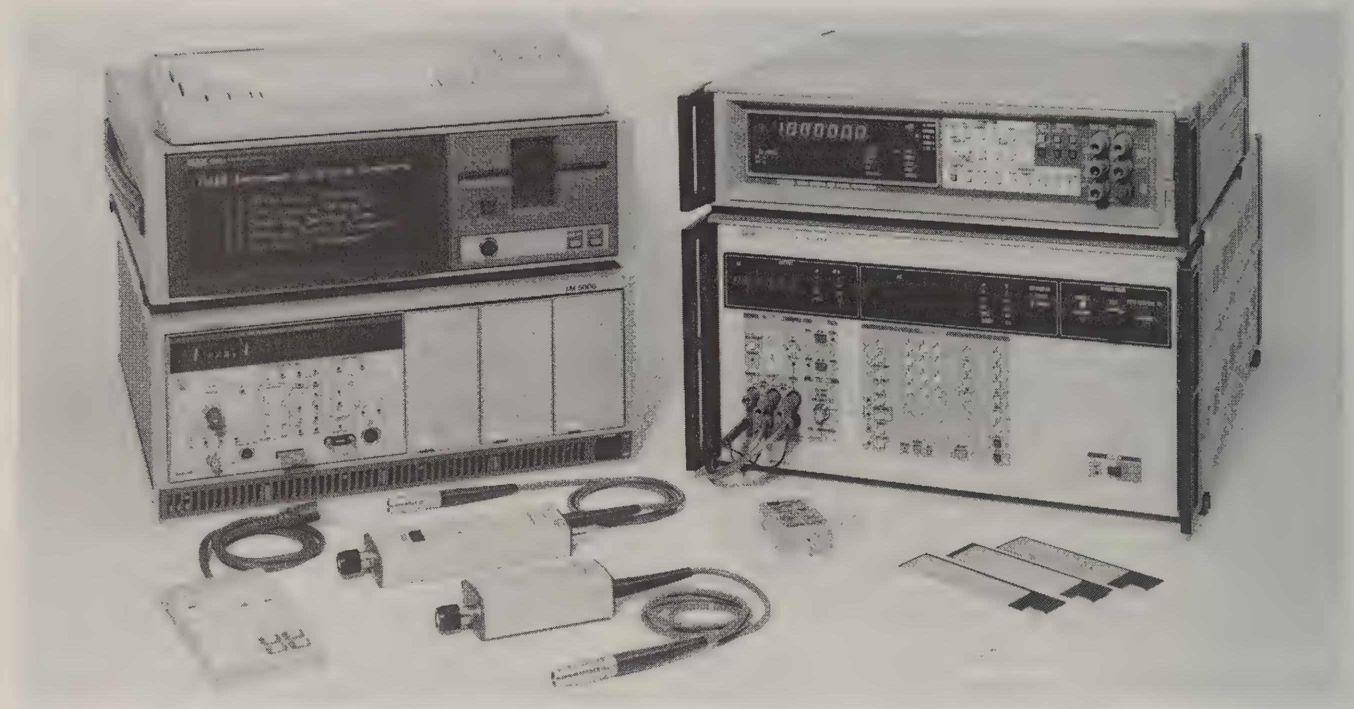
After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

IEEE-488

COMPUTER-AIDED CALIBRATION

7449A Computer-Aided Oscilloscope/Meter Calibration Cluster



7449A

7449A Computer-Aided Oscilloscope/Meter Calibration Cluster

- Saves you time and money from the day of installation
- Protects your past and future investments
- Oscilloscope and meter calibration
- All 7404B capabilities included
- 7411A Calibration-At-A-Keystroke Software included
- Numerous oscilloscope and meter calibration procedures included

The Fluke 7449A Computer-Aided Oscilloscope/Meter Calibration Cluster adds oscilloscope calibration capability to the already impressive line up of capabilities of the Fluke 7404B Calibration Cluster. With the 7449A you get calibration and verification capability of oscilloscope vertical gain, horizontal timing and gain, vertical pulse characteristics, probe accuracy and compensation, current probe accuracy, and calibrator output accuracy along with up to six function meter calibration and measurement. In the 7449A durable instrumentation joins reliable software to give you combined meter/oscilloscope calibration on which you can depend.

The Fluke 7449A gives you the Fluke 5100B Multifunction Calibrator, the Fluke 8506A Digital Multimeter for measurement and accuracy enhancement, and the Tektronix CG5001 Oscilloscope Calibrator, all controlled via IEEE-488 bus by the Fluke 1722A Instrument Controller.

The 7449A gives you up to six function meter calibration with a basic direct voltage uncertainty of 13 ppm and alternating voltage uncertainty to 190 ppm. Plus, for oscilloscope calibration you get voltage output amplitude from 40 μV to 200V, time markers from 400 pS to 5S, a risetime less than 200 pS, square wave amplitude accuracy of 0.25%, and measurement capability.

All this capability is controlled by the Fluke 1722A Instrument Controller featuring the Touch-Sense Display. Extremely fast command execution, advanced instrument control capabilities, and expansive memory give the 1722A important advantages over personal computers as the "brain" of your computer-aided benchtop cluster.

The 7449A has been designed to be very easy to use. With the 7449A you can get good calibration results from operators with little calibration experience. Instructions are presented on the screen of the 1722A, operators make their choices via the Touch-Sense Display or via the convenient Operator's Aid, and results are automatically recorded.

Upgrade Your 7404B or CG5001 To A 7449A

If you already own a Tektronix CG5001 Oscilloscope Calibrator, a Fluke 7404B Computer-Aided Meter Calibration Cluster, or other instruments used in the 7404B, you can upgrade to a 7449A by adding the instruments you need and putting them under control of the Fluke 1722A Instrument Controller and 7411A Calibration-At-A-Keystroke Software. Compare your existing equipment with the Standard 7449A Components listed below, note what you still need, then order only those items you need to complete the upgrade.

The standard 7449A consists of the following items:

- 7404B Computer-Aided Meter Calibration Cluster consisting of:
  Fluke 5100B with a 5100A-05 IEEE-488 interface option.
  Fluke 8506A with an 8500A-05 IEEE-488 interface option.
  Fluke 1722A with a 17XXA-007 512K-byte RAM option.
  Fluke 7404B-800 User Interface/Accessories option containing:
    7411A Calibration-At-A-Keystroke Software
    7400A-997 Operator's Aid, a small handheld keypad that the operator uses in conjunction with the 1722A's Touch-Sense Display to control the 7449A.
    7400A-996 AC Divider, a small ac divider used to reduce the alternating voltage output of the 5100B to the millivolt level when calibrating rf meters or trigger levels at low frequencies.
    Y8021 Three shielded, one meter long IEEE-488 bus cables.
    Y8404 Analog Accuracy Enhancement cable used to connect the 5100B voltage outputs to the 8506A's rear inputs.

- Fluke 7409A-400 consisting of a Fluke-supplied, serviced, warranted, and supported:
  Tektronix CG5001 Oscilloscope Calibrator with
    Output cable assembly (Tektronix part number 012-0884-00)

Pulse head (Tektronix part number 015-0311-01)
Comparator head (Tektronix part number 015-0310-01)
TM5006 mainframe with CG5001 installed
Three blank plug-in panels (Tektronix part number 016-0195-03)
Fluke Y8021 shielded one meter long IEEE-488 bus cable

7411A Software Is Ready When You Expand Your 7449A

The 7411A Calibration Software supplied with the 7449A is fully compatible with expansion of the 7449A's capabilities. 7411A software supports the addition of a synthesized signal generator such as the Fluke 6060A Signal Generator. It also supports the addition of other calibrators for improved meter calibration performance (see the 7404B description for more information). A printer can also be added for hard copy of test results and calibration constants. A full list of instruments supported by 7411A Calibration Software is on page 131.

Specifications

Voltage (Amplitude Mode)

The standard voltage is used to calibrate vertical display accuracy.
Range: 40 μV to 200V (1-2-5 steps with multiplier)
Multipliers: 1, 2, 3, 4, 5, 6, 8, 10 divisions
Polarity: Positive from ground
Accuracy: ±(0.25% ±1 μV)
Frequency: DC or 10 Hz to 100 kHz (decade steps). 40 mV to 80 mV from 10 Hz to 100 kHz; 100 mV to 10V from 10 Hz to 100 kHz, or dc; 12V to 200V from 10 Hz to 10 kHz, or dc
Variable Range: ±9.9%

Current (Amplitude Mode)

The standard current is used to calibrate current probes.
Range: 1 mA to 100 mA (1-2-5 sequence)
Multipliers: 1, 2, 3, 4, 5, 6, 8, 10
Accuracy: ±(0.25% +2 μA)
Frequency: Dc or 10 Hz to 1 MHz (decade steps)
Variable Range: ±9.9%

Edge (Amplitude Mode)

The low distortion pulses obtained in this mode are used to test oscilloscope input amplifier and attenuator compensation.
Low Range: 20 mV to 1V (1-2-5 steps with multipliers)
  Polarity: Positive or negative transitions to ground
  Rise Time or Fall Time: <1.3 ns
  Aberrations: ±2%
  Long Term Flatness: ±0.5% after first 10 ns
  Frequency: 10 Hz to 1 MHz (decade steps)
  Variable Amplitude Range: >±10% from nominal
  Termination: 50Ω
High Range: 1.2V to 100V (1-2-5 steps with multipliers)
  Polarity: Negative voltage, rising to ground
  Rise Time: <100 ns
  Aberrations: ±2%
  Long Term Flatness: ±0.5% after first 500 ns
  Frequency: 10 Hz to 100 kHz (decade steps)
  Variable Amplitude Range: >±10% from nominal
  Termination: ≥1 MΩ

Markers (Timing Mode)

The markers obtained in this mode are used to calibrate oscilloscope time bases.
Range: 5s to 10 ns (1-2-5 steps)
Accuracy: ±0.01%
Amplitude: 1 volt minimum into 50Ω
Variable Range: ±9.9%

Slewed Edge (Timing Mode)

Slewed edges are used to calibrate the very fastest ranges found on oscilloscope timebases.
Range: 100 ns to 0.4 ns (1-2-5 steps plus 0.4 ns)
Accuracy: ±0.01%
Edge Position Uncertainty: ±40 ps
Amplitude: >1V into 50Ω
Variable Range: ±9.9%

Trigger Output Rate

The oscilloscope under test may be triggered externally from this source. The output amplitude is 1 volt (minimum) into 50Ω.
Marker Mode
  Normal: Slaved to marker rate from 5s to 100 ns, remains at 100 ns for faster markers
  Divided by 10: Reduces normal trigger rate by a factor of ten
  Divided by 100: Reduces normal trigger rate by a factor of one hundred
Slewed Edge Mode: One trigger per slewed edge. (Rate divided by 10 and divided by 100 not available) .
All Other Modes
  Normal: Slaved to output frequency
  Divided by 10: One-tenth output frequency
  Divided by 100: One-hundredth output frequency

Pulse Head

The Pulse Head is used to generate fast-rise, low-distortion pulses for testing higher bandwidth vertical amplifiers.
Amplitude: 1.1 volt peak ±5% into 50Ω
Adjustable Range: ±10%
Rise Time: ⩽200 ps
Polarity: Positive or negative from ground
Aberrations: ±3% of pulse amplitude; not to exceed 4% peak-to-peak for adjacent peaks for zero to 50 ns
Frequency: 100 Hz to 100 kHz (decade steps)

Comparator Head

The Comparator Head is used to calibrate built-in oscilloscope calibrators against the signals available from the system. Both the oscilloscope calibrator and CG 551AP standard amplitude signals are applied to the Comparator Head and simultaneously displayed on the oscilloscope CRT. The CG 551AP signals are then varied to obtain congruent displays.
Input
  AC Voltage: ±40 μV to ±100V, 10 Hz to 1 MHz — squarewave
  DC Voltage: -100 mV to +100V
Resistance
  Open: Unterminated (the resistance of the oscilloscope input)
  50Ω: 50Ω ±1% in 50Ω position. Maximum voltage is ±5V peak in the 50Ω position
Chop Parameters
  Frequency: 30 Hz nominal. (Auto)
  Auto Timeout: Internally selectable 0.5, 1 or 2 minutes
  For complete specifications see Tektronix CG 5001 manual.

Model

January 1986 prices

7449A Computer-Aided Oscilloscope/Meter Calibration Cluster	$46,910

Options

7409A-400 Tektronix CG5001 Oscilloscope Calibrator w/Y8021 IEEE-488 bus cable	19,960
1722A-007 512K-byte RAM expansion for 1722A	2250
1722A-008 IEEE-488/RS232C interface for 1722A	590
7400A-700 Procedure Writing Training	760

Accessories (Also see page 230)

Y8021 Shielded, 1m IEEE-488 bus cable	85
Y8022 Shielded, 2m IEEE-488 bus cable	95
Y8023 Shielded, 4m IEEE-488 bus cable	105

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

IEEE-488

COMPUTER-AIDED CALIBRATION

7405A Multimeter Calibration Workstation

7405A

7405A Multimeter Calibration Workstation

- Save time and money from the time of installation
- Protect past and future investments
- Efficient, productive meter calibration
- 7411A Calibration Software included
- Numerous calibration procedures included

The 7405A is a fully automated, precision calibration workstation. It can rapidly and accurately calibrate a wide range of meters including DMMs, DVMs, VTVMs, and VOMs as well as voltage and current sources, power supplies, amplifiers, and passive devices.

A basic 7405A is comprised of a fully integrated group of Fluke measurement and calibration instuments — the 5100B Multifunction Calibrator, the 8505A Digital Multimeter, and the 1722A Instrument Controller — built into a console having a single unique Test Interface Panel. Switching circuitry in the test panel provides functional self tests. Innovative software combined with the test panel enhances the 7405A accuracy (e.g., 20 ppm for dV, 0.025% for aV) making 7405A specifications exceed those of the stand-alone instruments.

The software package offers clear advantages over other automated calibration systems. Experienced programmers are not needed; calibration procedures can be written without learning any computer language. The 7405A accepts instructions using calibration terminology that calibration people know. Automated test procedures which formerly took specialists several days to write can now be produced in less than an hour.

When you purchase a 7405A you also get the 7411A Calibration-At-A-Keystroke Software, a software package you can depend on. 7411A includes calibration procedures for meters manufactured by most major vendors today. Remember that 7411A calibration procedures you write or supplied by Fluke are onward compatible with future offerings from Fluke.

Specifications

Stimulus Specifications

Direct Voltage Source
Total Output Range: 0 to ±1100V
Best Accuracy: ±(0.001% of output + 0.004% of range)
For Outputs Of: 0 to ±20V on 1V and 10V ranges

Alternating Voltage Source
Total Output Range: 0 to 1100V at 1 kHz (1100V to 50 kHz with Option -100
Best Accuracy: ±(0.015% of output + 0.005% of range)
For Outputs Of: 0 to ±500V on 1V, 10V, 100V and 1000V ranges, 100 Hz to 5 kHz
Frequency Range: 50 Hz to 50 kHz

Wideband Mode

Total Output Range: 300 μV to 3.1623V in eight dB structured ranges
Best Accuracy: ±(0.25% of output + 8 mV) on the 1V to 3.1623V range
Best Flatness: 0.25% of output from 50 Hz to 2 MHz on all ranges above 1 mV
Output Impedance: 50 ohms

Direct Current Source

Total Output Range: ±10 μA to 2A (±2A to 20A with Option -120)
Best Accuracy: ±(0.025% of output + 0.005% of range)
For Outputs Of: ±2 mA to ±2A on 10 mA, 100 mA, and 1A ranges

Alternating Current Source

Total Output Range: ±10 μA to 2A (±2A to ±20A with Option -120)
Best Accuracy: ±(0.07% of output + 0.02% of range)
For Outputs Of: >2 mA to 2A on ranges of 10 mA, 100 mA, and 2A, 50 Hz to 1 kHz
Frequency Range: 50 Hz to 1 kHz

Resistance, Fixed Values

Cardinal Points: 1Ω, 10Ω, 100Ω, 1 kΩ, 10 kΩ, 1 MΩ, and 10 MΩ
Best Accuracy: ±0.005%
For Outputs Of: 100Ω to 100 kΩ

Resistance, Variable Values

An active technique is provided to simulate resistance and conductance sources. The technique is useful for meters that provide a constant current through the test reference. Fluke models 8600A and 8800A are examples of such meters.

Measurement Specifications

Direct Voltage

Total Input Range: 0 to ±1100V
Best Accuracy: ±(0.001% + 80 μV)
For Inputs Of: 0 to ±20V

Alternating Voltage

Total Input Range: 0 to 1100V
Best Accuracy: ±(0.015% + 0.01% of range)
For Inputs Of: 0.2V to 500V on 1V, 10V, 100V, and 1000V ranges, 100 Hz to 300 kHz
Frequency Range: dc to 300 kHz

Resistance:

Total Input Range: 0Ω to 262.144 MΩ
Best Accuracy: ±(0.003% + 0.0008% of range)
For Inputs Of: >250Ω to 256 kΩ on 1 Ω, 10Ω, and 100 kΩ ranges

Direct Current

Total Input Range: 0 to ±1.28A
Best Accuracy: ±(0.03% + 0.01% of range)
For Inputs Of: 0 to ±10 mA on 100 μA, 1 mA, and 10 mA ranges

Alternating Current

Total Input Range: 0 to 1.28A
Best Accuracy: ±(0.11% + 0.035% of range)
For Inputs Of: 0 to 10 mA on 1 mA and 10 mA ranges, 50 Hz to 10 kHz

Option Specifications

Power Amplifier Option (-100)

Includes Fluke 5205A Precision Power Amplifier for alternating voltage to 1100 volts. Option -150 and Option -500 (or -501) are required; order separately. Integrated and tested as a system. For more information see 5205A pages in this catalog.

Transconductance Amplifier Option (-120)

Includes Fluke 5220A Transconductance Amplifier for current source to 20 amperes. Option -150 and Option -500 (or -501) are required, order separately. Integrated and tested as a system. For more information see 5220A pages in this catalog.

Interface Option (-500)

Includes Y5000 Interface accessory. Required for Option -100 and/or Option -120.

Counter/Timer Option (-200)

Includes Fluke 1953A Counter/Timer. Installed in standard cabinet and tested as a system.

Rack Cabinet Option (-500)

Includes power distribution panel, rack adapters and slides for Options -100 and -120, cables for Options -150, and cooling ducts. Fully tested.

Rack Cabinet Option (-501)

Same as Option -500 except for 230V ac power lines, etc.

Workstation Option (-520)

Incorporates a large work surface, storage area, and a 1722A Instrument Controller mounting arm.

Additional Manual Set Option (-600)

One complete extra set of 7405A Manuals.

Intermediate Training Option (-700)

Includes five days of training at Fluke Park, Everett, Washington, U.S.A. Contact Fluke service for details.

General Specifications

Temperature: +10°C to +40°C, operating; -10°C to +60°C, non-operating
Relative Humidity: ⩽70% from +18°C to +40°C
Power Line: 100V, 120V, or 230V ac ±10%, 50 Hz to 60 Hz

Power

Standard Cabinet: 500 VA fully loaded (including 1722A); 470 VA without 1953A (Option -200)
Accessory Cabinet: 1925 VA fully loaded; 325 VA without 5205A (Option -100); 1000VA without 5220A (Option -120)

Size

Standard or Accessory Cabinet: 110 cm H x 61 cm W x 87.6 cm D (43.3 in x 24 in x 34.5 in)
1722A Controller: 14.6 cm H x 43.2 cm W x 62.2 cm D (5.25 in x 17 in x 20 in)
Workstation: 103 cm H x 81.3 cm W x 121 cm D (40.7 in x 32 in x 47.5 in). Table leaf is 61 cm wide (24 in)

Weight

Standard Cabinet: Approximately 186 kg (410 lb) fully loaded; 182 kg (401 lb) without 1953A (Option -200)
Accessory Cabinet: Approximately 211 kg (465 lb) fully loaded; 157 kg (345 lb) without 5205A (Option -100); 188 kg (415 lb) without 5220A (Option -120)
1722A Controller: 17.4 kg (38 lb)
Workstation: Approximately 73 kg (161 lb)

Model

	January 1986 prices
7405A Automated Calibration Workstation	$50,900

Options

7405A-100 Precision Power Amplifier (requires both -150 and -500 Options)	10,795
7405A-120 Transconductance Amplifier (requires both -150 and -500 Options)	5610
7405A-150 5100-Series Interface	585
7405A-200 Frequency Counter/Timer	2790
7400A-300 Printer	2295
7405A-500 Rack with Cabinet	3995
7405A-501 Same as -500, but 230V version	3995
7400A-520 Controller Workstation	1895
7405A-600 Additional Manual Set	395
7405A-700 Four Day Training Course	570
7400A-700 Procedure Writing Training	760

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

COMPUTER-AIDED CALIBRATION

7410A Automated Oscilloscope Calibration Workstation

7410A

7410A Automated Oscilloscope Calibration Workstation

- Saves you time and money now while protecting your past and future investments
- Efficient and productive oscilloscope calibration
- 7411A Calibration Software included
- Numerous oscilloscope calibration procedures included

The Fluke 7410A is a fully integrated, automated calibration workstation which rapidly and accurately calibrates oscilloscopes of any manufacturer. It also verifies and calibrates plug-ins, probes, amplifiers, calibration fixtures, and related devices. The 7410A can be customized by the user to accommodate additional workloads.

The Fluke 7410A combines the powerful 1722A Instrument Controller with the Tektronix CG5001 Programmable Calibration Generator. Other Fluke instrumentation provides additional measurement and stimulus capability to address the bulk of scope workload.

With the 7410A you increase throughput and reliability. This improvement in quality and productivity results from the 7411A Calibration Software included with each workstation. The 7411A is both extensive and operator-oriented. Your productivity will increase as your workload does, reducing your cost per calibration. This alone can often justify the purchase of a 7410A.

You get software you can depend on; the 7411A has been thoroughly tested and field proven by Fluke. The 7411A package includes calibration procedures for oscilloscopes manufactured by most major vendors. Use these procedures as they are, modify them to fit your needs, or easily write new procedures of your own. All 7411A procedures are onward compatible with future offerings from Fluke.

Specifications

Voltage (Amplitude Mode)

The standard voltage is used to calibrate vertical display accuracy.

Range: 40 μV to 200V (1-2-5 steps with multiplier)
Multipliers: 1, 2, 3, 4, 5, 6, 8, 10 divisions
Polarity: Positive from ground
Accuracy: ±(0.25% ±1 μV)
Frequency: DC or 10 Hz to 100 kHz (decade steps). 40 mV to 80 mV from 10 Hz to 100 kHz; 100 mV to 10V from 10 Hz to 100 kHz, or dc; 12V to 200V from 10 Hz to 10 kHz, or dc
Variable Range: ±9.9%

Current (Amplitude Mode)

The standard current is used to calibrate current probes.

Range: 1 mA to 100 mA (1-2-5 sequence)

Multipliers: 1, 2, 3, 4, 5, 6, 8, 10 divisions
Polarity: Positive from ground
Accuracy: ±(0.25% ±1 μV)
Frequency: DC or 10 Hz to 100 kHz (decade steps). 40 mV to 80 mV from 10 Hz to 100 kHz; 100 mV to 10V from 10 Hz to 100 kHz, or dc; 12V to 200V from 10 Hz to 10 kHz, or dc
Variable Range: ±9.9%

Current (Amplitude Mode)

The standard current is used to calibrate current probes.
Range: 1 mA to 100 mA (1-2-5 sequence)
Multipliers: 1, 2, 3, 4, 5, 6, 8, 10
Accuracy: ±(0.25% +2 μA)
Frequency: Dc or 10 Hz to 1 MHz (decade steps)
Variable Range: ±9.9%

Edge (Amplitude Mode)

The low distortion pulses obtained in this mode are used to test oscilloscope input amplifier and attenuator compensation.
Low Range: 20 mV to 1V (1-2-5 steps with multipliers)
Polarity: Positive or negative transitions to ground
Rise Time or Fall Time: <1.3 ns
Aberrations: ±2%
Long Term Flatness: ±0.5% after first 10 ns
Frequency: 10 Hz to 1 MHz (decade steps)
Variable Amplitude Range: >±10% from nominal
Termination: 50Ω
High Range: 1.2V to 100V (1-2-5 steps with multipliers)
Polarity: Negative voltage, rising to ground
Rise Time: <100 ns
Aberrations: ±2%
Long Term Flatness: ±0.5% after first 500 ns
Frequency: 10 Hz to 100 kHz (decade steps)
Variable Amplitude Range: >±10% from nominal
Termination: ≥1 MΩ

Markers (Timing Mode)

The markers obtained in this mode are used to calibrate oscilloscope time bases.
Range: 5s to 10 ns (1-2-5 steps)
Accuracy: ±0.01%
Amplitude: 1 volt minimum into 50Ω
Variable Range: ±9.9%

Slewed Edge (Timing Mode)

Slewed edges are used to calibrate the very fastest ranges found on oscilloscope timebases.
Range: 100 ns to 0.4 ns (1-2-5 steps plus 0.4 ns)
Accuracy: ±0.01%
Edge Position Uncertainty: ±40 ps
Amplitude: >1V into 50Ω
Variable Range: ±9.9%

Trigger Output Rate

The oscilloscope under test may be triggered externally from this source. The output amplitude is 1 volt (minimum) into 50Ω.
Marker Mode
Normal: Slaved to marker rate from 5 s to 100 ns, remains at 100 ns for faster markers
Divided by 10: Reduces normal trigger rate by a factor of ten
Divided by 100: Reduces normal trigger rate by a factor of one hundred
Slewed Edge Mode: One trigger per slewed edge. (Rate divided by 10 and divided by 100 not available)
All Other Modes
Normal: Slaved to output frequency
Divided by 10: One-tenth output frequency
Divided by 100: One-hundredth output frequency

Pulse Head

The Pulse Head is used to generate fast-rise, low-distortion pulses for testing higher bandwidth vertical amplifiers.
Amplitude: 1.1 volt peak ±5% into 50Ω
Adjustable Range: ±10%
Rise Time: ≤200 ps
Polarity: Positive or negative from ground
Aberrations: ±3% of pulse amplitude; not to exceed 4% peak-to-peak for adjacent peaks for zero to 50 ns
Frequency: 100 Hz to 100 kHz (decade steps)

Comparator Head

The Comparator Head is used to calibrate built-in oscilloscope calibrators against the signals available from the system. Both the oscilloscope calibrator and CG 551AP standard amplitude signals are applied to the Comparator Head and simultaneously displayed on the oscilloscope CRT. The CG 551AP signals are then varied to obtain congruent displays.
Input
AC Voltage: ±40 μV to ±100V, 10 Hz to 1 MHz—squarewave
DC Voltage: -100 mV to +100V
Resistance
Open: Unterminated (the resistance of the oscilloscope input)
50Ω: 50Ω ±1% in 50Ω position. Maximum voltage is ±5V peak in the 50Ω position
Chop Parameters
Frequency: 30 Hz nominal. (Auto)
Auto Timeout: Internally selectable 0.5, 1 or 2 minutes
For complete specifications see Tektronix CG 5001 manual.

Measurement Specifications

DC Voltage Measurements
Input Characteristics

Range	Full Scale	Resolution	Input Resistance
100 mV	199.999	1 μV	≥10,000 MΩ
1V	1.99999	10 μV	≥10,000 MΩ
10V	16.0100	100 μV	≥10,000 MΩ
100V	130.100	1 mV	10 MΩ
1000V*	1024.00	10 mV	10 MΩ

**To 6 kV with 80K-6 high voltage probe (included)*

Accuracy: ±(% of Input + Digits)

Range	24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C
100 mV	0.003 + 6	0.0065 + 7	0.011 + 11
1V	0.003 + 1	0.006 + 2	0.011 + 2
10V	0.002 + 1	0.005 + 1	0.009 + 1
100V	0.003 + 1	0.007 + 2	0.012 + 2
1000V	0.0035 + 1	0.0065 + 1	0.011 + 11

Maximum Input: ±1000V peak, HI to LO; ±20V peak GUARD to chassis terminal and GUARD to LO terminal, for any range

High DC Voltage Measurements

Using an 80K-6 High Voltage Probe supplied with each 7410A, measurements of 1000V to 6000V dc may be made with an accuracy of ±1%. The probe has an impedance of 75 MΩ ±25 MΩ. Up to 40 kV may be measured using the optional 80K-40 probe.

AC Voltage Measurements (True RMS)

Range	Full Scale	Resolution	Input Impedance
1V	1.99999	10 μV	1 MΩ, ≤290 pF at the V/Ω input terminal
10V	16.0100	100 μV	
100V	130.100	1 mV	
650V	650.000	10 mV	

7410A Automated Oscilloscope Calibration Workstation

Accuracy: ±(% of Input + % of Full Scale)*

Frequency	24 Hours 23°C ±1°C			90 Days 23°C to 28°C			1 Year 18°C to 28°C		
	% of Input	+%FS AC	+%FS AC+DC	% of Input	+%FS AC	+%FS AC+DC	% of Input	+%FS AC	+%FS AC+DC
40 Hz to 20 kHz	0.08	0.02	0.06	0.1	0.03	0.08	0.15	0.05	0.16
20 kHz to 100 kHz	1.0	0.3	0.4	1.0	0.3	0.4	2.0	0.6	0.8
100 kHz to 300 kHz	2.4	0.6	0.6	2.4	0.6	0.6	4.0	1.0	1.0
300 kHz to 1 MHz	8.0	2.5	2.5	8.0	2.5	2.5	15.0	5.0	5.0

** From 0.1% of range to full scale. For 650V range multiply percent of full scale by 1.6.*

Maximum Input: ±1000V peak, HI to LO; ±20V peak GUARD to chassis terminal and GUARD to LO terminal, for any range
Volt-Hertz Product: ≤2x10^7
Slew Rate: ≤177V per microsecond
Crest Factor: Exceeds 4:1 at full scale, increasing downscale

Resistance Measurements
Input Characteristics

Range	Full Scale	Resolution	Current Thru Unknown
10Ω	19.9999	100 μΩ	10 mA
100Ω	199.999	1 mΩ	10 mA
1000Ω	1999.99	10 mΩ	1.0 mA
10 kΩ	19.9999	100 mΩ	0.1 mA
100 kΩ	199.999	1Ω	14.5 μA (max)
1 MΩ	1.99999	10Ω	1.5 μA (max)
10 MΩ	19.999	1 kΩ	1.5 μA (max)
100 MΩ*	100 MΩ	*	1.5 μA (max)

**Using Conductance mode*

Accuracy: ±(% of Input + Digits)

Range	24 Hours 23°C ±1°C	90 Days 18°C to 28°C	1 Year 18°C to 28°C
10Ω	0.0045 + 6	0.0080 + 7	0.0140 + 12
100Ω	0.0035 + 2	0.0070 + 2	0.0125 + 3
1000 Ω	0.0035 + 2	0.0070 + 2	0.0125 + 3
10 kΩ	0.0035 + 2	0.0070 + 2	0.0125 + 3
100 kΩ	0.0040 + 2	0.0090 + 2	0.0140 + 3
1 MΩ	0.0090 + 2	0.0160 + 2	0.0200 + 3
10 MΩ	0.0300 + 1	0.0440 + 1	0.0450 + 3
100 MΩ*	0.0400 + 5	0.0500 + 5	0.0600 + 5

** Using Conductance mode. When the instrument is operated in the 10 nS to 100 nS range the resolution is 0.001 nS. Therefore, if the reading is converted to ohms the resolution is 0.1 MΩ for a 100 MΩ reading and 0.001 MΩ for a 10 MΩ reading.*

Open Circuit Voltage: <8V
Maximum Input: ±400V peak for any range
For complete specifications see Fluke 8520A Manual.

Option Specifications

Includes Fluke 6011A Synthesized Signal Generator, installed and tested as a system.
Synthesized Signal Generator Option (-211)
Frequency Ranges: 10 Hz to 10.99999 MHz
Frequency Resolution: 10 Hz from 110 kHz to 11 MHz, 0.1 Hz from 10 Hz to 110 kHz
Frequency Accuracy: ±3 ppm per year over temperature range of 0° to 50°C
Amplitude Range, dBm: +26.98 dBm to -55.01 dBm, 50-ohm reference
Amplitude Range, Volts: 5.000V to 0.3972 mV rms into 50 ohm, 10.000V to 0.7944V rms open circuit
Amplitude Resolution, dB: 0.01 dB
Output Impedance: 50 ohms

Synthesized Signal Generator Option (-270)
Includes Fluke 6070A Synthesized Signal Generator, installed and tested as a system.
Frequency Range: 200 kHz to 519.999999 MHz
Frequency Resolution: 1 Hz
Frequency Accuracy: ±5 ppm from 0°C to 50°C ambient temperature
Amplitude Range: +19 dBm to -140 dBm
Amplitude Resolution: 0.1 dB or 1% (voltage)
Output Impedance: 50Ω
Amplitude Accuracy: ±1.8 dB from +19 to +13 dBm; ±(1.1 dB -0.01 times dBm level) from +7 to -131 dBm; ±4.3 dB from -131 to -141 dBm
Amplitude Flatness: ±0.55 dB over entire range at 10 dBm
Modulation Signal Output: 20 Hz to 200 kHz, 0V to 2V peak-to-peak into 600Ω
For more information see 6070A/6071A pages in this catalog.

Includes Fluke 6071A Synthesized Signal Generator, installed and tested as a system.

Synthesized Signal Generator Option (-271)
Includes Fluke 6071A Synthesized Signal Generator, installed and tested as a system.
Frequency Range: 200 kHz to 1039.999998 MHz
Frequency Resolution: 1 Hz to 520 MHz; 2 Hz above 520 MHz
Amplitude Range: +19 dBm to -140 dBm below 520 MHz; +13 dBm to -140 dBm above 520 MHz
Amplitude Flatness: ±0.65 dB at 4 dBm
Amplitude Accuracy: Same as Option -270 below 520 MHz. Above 520 MHz: ±2.8 dB from +13 to +7 dBm; ±(1.9 dB -0.015 times dBm level) from +7 dBm to -131 dBm
Other Specifications: Same as for Option -270
For more information see 6070A/6071A pages in this catalog.

Line Printer Option (-300)
Includes line printer, printer stand, paper tray, paper, and RS-232-C Interface Cable, all tested as a system.

Workstation Option (-520)
Incorporates a large work surface, storage area, and a 1720A Instrument Controller mounting arm.

Additional Manual Set Option (-600)
One complete extra set of 7410A Manuals.

Intermediate Training Option (-700)
Includes five days of training at Fluke Park, Everett, Washington, U.S.A. Contact Fluke Service for details.

General Specifications

Temperature: +10°C to +40°C, operating; -10°C to +60°C, non-operating
Relative Humidity: ≤70% from +18°C to +40°C
Power Line: 108V to 127V ac or 216V to 254V ac, 50 Hz to 60 Hz
Power: 525 VA fully loaded, including 1720A, 6011A, and 6070A (or 6071A). 425 VA without 6011A. 400 VA without 6070A (or 6071A). 300 VA without 601A, 6070A, or 6071A. For unit under test, 400 VA maximum.
Size
Standard Cabinet: 110 cm H x 61 cm W x 87.6 cm D (43.3 in x 24 in x 34.5 in)
1722A Controller: 14.6 cm H x 43.2 cm W x 62.2 cm D (5.25 in x 17 in x 20 in)
Workstation: 103 cm H x 81.3 cm W x 121 cm D (40.7 in x 32 in x 47.5 in). Table leaf is 61 cm wide (24 in)
Weight
Standard Cabinet: Approximately 163 kg (360 lb) fully loaded, including 6011A and 6070A (or 6071A) but excluding 1722A, Workstation, or 1776A Printer. Approximately 151.6 kg (335 lb) without 6011A. 135.3 kg (299 lb) without 6070A (or 6071A). 125 kg (274 lb) without 6011A, 6070A or 6071A.
1722A Controller: 17.4 kg (38 lb)
Workstation: Approximately 73 kg (161 lb)
1775A or 1776A Printer: 29 kg (64 lb)

COMPUTER-AIDED CALIBRATION

7410A Automated Oscilloscope Calibration Workstation

Model

Model	January 1986 prices
7410A Automated Calibration Workstation	$49,610

Options

7410A-211 w/6011A Signal Source	6520
7410A-270 w/6070A Signal Source	18,645
7410A-271 w/6071A Signal Source	19,995
7410A-600 Additional Manual	395
7400A-300 w/1776A Printer	2295
7400A-520 Workstation Table	1895
7400A-700 Four Day Procedure Writing Training	760

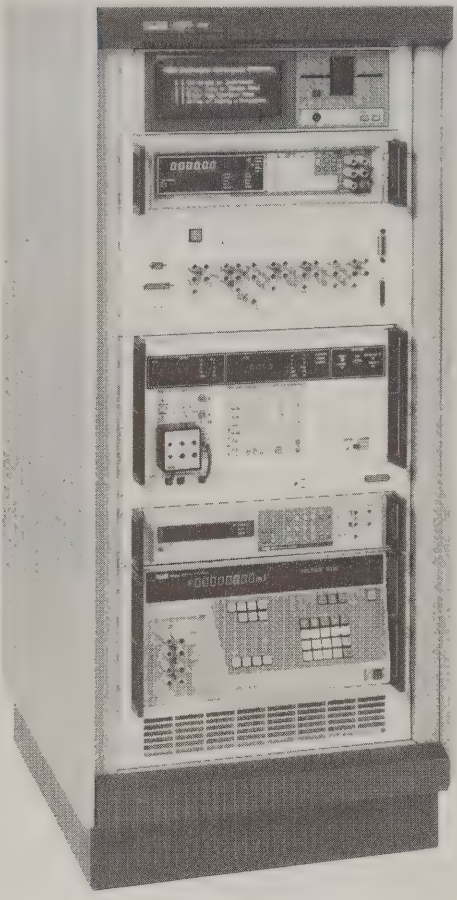
Accessories (Also see page 230)

80K-40 High Voltage Probe	80
Y1706 Pack of 10 Blank Disks	100
Y1715 Additional box of printer paper	50

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

Automated Calibration Workstations — Special



A123-CO

Special Automated Calibration Workstations

- Automated state-of-the-art accuracy
- Configurable to fit your calibration needs
- Combined meter/oscilloscope capability in one workstation
- Mobile automated calibration workstations

Flexibility is the key word for Fluke's new state-of-the-art special automated calibration workstations. Now you can select the instrument combinations necessary to automate your calibration needs. Fluke offers a wide selection of both meter and oscilloscope calibration instruments which can be configured to satisfy your requirements and your budget.

Fluke offers two standard configurations of A123 system, each with a wide variety of options for meters and oscilloscopes. These workstations combine the accuracy of computer-aided calibration, the convenience of a test interface panel and the flexibility of semi-customized configurations to meet virtually any application required by metrologists all over the world. These workstations can be mounted in mobile racks to allow the calibrator to be easily transported to the work site.

If these standard systems do not perfectly fit your requirements, Fluke will configure arrangements of the instruments listed in the table on page 129. Contact your local Fluke Sales Office for help in configuring a workstation.

The Fluke A123 — The World's Most Accurate Automated Meter Calibration Workstation

The Fluke A123 is a computer-aided automated calibration workstation which can be configured in a variety of ways to calibrate even the most accurate DMMs and oscilloscopes. All systems provide complete sourcing capabilities of direct volts, alternating volts, direct current, alternating current and resistance as well as measuring capability for direct volts, alternating volts, and resistance. Optional equipment can be added to extend the frequency range and also boost the alternating voltage output and current output.

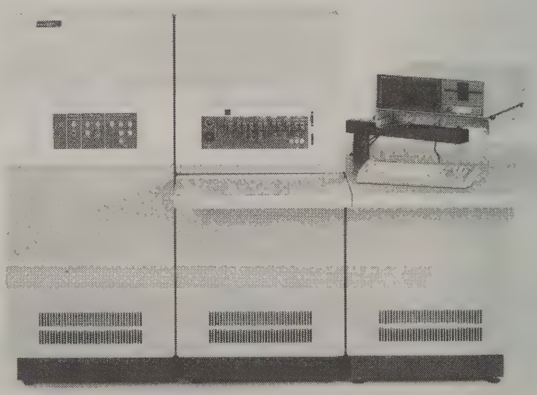
One of the major benefits of owning a Fluke computer-aided calibration system is that you can enhance your system as your workload changes or budget money becomes available. The graph on page 132 illustrates the growth path from a simple 5100B Multifunction Meter Calibrator to an A123 system providing full state-of-the-art source accuracy for meters and oscilloscopes.

Procedure generation and system control are accomplished by Fluke's 7411A Calibration-at-a-Keystroke Software. This software allows a procedure writer, who knows how to write calibration procedures in technical English, to produce the computer files necessary to operate the A123 without knowing any formal computer language. The 7411A will prompt the procedure writer to choose Function Selection Codes (FSC) and to enter the data required to calibrate a particular instrument such as a DMM.

At calibration time, the 7411A uses the procedure data previously entered by the procedure writer to execute a calibration sequence. The operator interfaces with this sequence by responding to requests appearing on the 1722A touch sensitive display. Replies are entered either through the touch sensitive display or by pressing the appropriate button on the handheld operator's aid.

The unit under test (UUT) is connected to the A123 through the Test Interface Panel (TIP). This provides all the connectors for the system instruments as well as the controller's data ports. The UUT can be connected to the 1722's port for closed-loop calibration via the IEEE-488 bus. In this case, the operator simply starts the calibration test and the system digitally calibrates itself and the UUT.

The calibration philosophy is constantly changing. In many cases, it is much more cost effective to take the calibration equipment to the instruments to be calibrated, instead of the reverse, which was the practice a few years ago. The size, ruggedness, and temperature specifications of modern equipment make this possible now. All Fluke A123 Automated Calibration Workstations can be mounted on optional mobile bases with semi-pneumatic wheels which provide a smooth ride over the factory floor.



Customized A123 System

"Cost Optimized" A123 for DMM Calibration (A123-CO)

"Cost Optimized Calibration" is a philosophy developed by Fluke many years ago to allow the cal lab manager to find a balance between increasing calibration confidence and reducing cost. The goal is the same: getting the most out of your calibration budget. In cost optimized calibration, the lab manager selects calibration equipment that has sufficient precision and capability to provide the level of calibration confidence required and the available budget. Whatever starting level is chosen, expansion to a higher level is always possible when extra funding becomes available. The software and calibration procedures remain compatible and there are no dead ends.

In the "cost optimized" A123-CO, only the alternating voltage and high current are performance optimized, all other functions provide sufficient precision and capability for the most modern high accuracy DMMs. The alternating voltage function of multimeters can be accurately calibrated to 180 ppm within the maximum volt/hertz product (1000V at 1 kHz decreasing to 20V at 50 kHz). This can be enhanced by the addition of the 5205A Precision Power Amplifier. Similarly, the 2 amp direct and alternating current output can be boosted to 20 amp by the optional 5220A Transconductance Amplifier.

A standard feature of A123-CO system is the 8506A Digital Multimeter which provides measurement capability for direct voltage, alternating voltage, and resistance. This is used to self-test the system.

Optional equipment may be added to the A123-CO Automated Workstation to provide highly accurate stimulus for oscilloscope calibration. The Tektronix CG5001 Oscilloscope Calibrator provides calibration and verification of oscilloscope gain, horizontal timing and gain, vertical pulse characteristics, and probe accuracy.

Similarly, a Fluke 6060B Synthesized Signal Generator can be added for oscilloscope calibration to provide a very pure sinewave output from 100 kHz to 1050 MHz. Low frequencies from 10Hz to 10 MHz can be provided by the 5100A-03 Option. To avoid degrading the output signal, the CG5001 and 6060B are not connected to the test interface panel.

The A123-CO consists of:

- 1722A Instrument Controller
  - -007 512K RAM
  - -008 IEEE-488 interface
- 8506A Thermal RMS Digital Multimeter
  - -02 Ohms
  - -05 IEEE-488 interface
- 5100B Multifunction Calibrator
  - -05 IEEE-488 interface
- 5440B Direct Volts Calibrator
- 5450A Resistance Calibrator
- A123 TIP Test Interface Panel with cables
- 48" Rack Assembly, Power Distribution and Fan
- 7411A Software package

Options for A123-CO are:

- 5205A Precision Power Amplifier
- 5220A Transconductance Amplifier
- CG5001 Oscilloscope Calibrator
- 6060B Synthesized Signal Generator
- 5100A-03 Wideband Output
- Additional 48" Rack Assembly, Power Distribution and Fan
- Mobile base for racks with semi-pneumatic wheels

Specifications

A123-CO Specifications

Meter Calibration (Sourcing)			
	Total Range	**Best Accuracy For Output Of**	
Direct Voltage	0 to 1100V	±(0.0003% +5 µV)	0 to 11V
Resistance	0 to 100 MΩ 18 Cardinal Points	±0.0006%	19 kΩ
Alternating Voltage	1 mV to 1100V 50 Hz to 50 kHz See 5100B Specs.	±(0.018% +20 counts)	125 mV to 110V 50 Hz to 20 kHz
Direct Current	0 to 2A	±(0.015 +2 counts 0.01 µA)	0 to 2A
Alternating Current	0 to 2A 50 Hz to 5 kHz	±(0.05% +5 counts +0.02 µA)	0 to 2A 50 Hz to 1 kHz
Optional Extended Specs With 5205A			
Alternating Voltage	100V to 1100V 50 Hz to 50 kHz	±(0.021% +0.01V)	100V to 600V 50 Hz to 10 kHz
With 5220A			
Direct Current	2A to 20A	±(0.025% + mA)	2A to 20A
Alternating Current	2A to 20A 50 Hz to 5 kHz	±(0.07% + mA)	2A to 20A 50 Hz to 1 kHz
Digital Multimeter (Measuring)			
	Total Range	**Best Accuracy For Output Of**	
Direct Voltage	0 to 1200V	±(8 ppm + 6 counts)	2V to 20V
Alternating Voltage	0 to 600V 10 Hz to 1 MHz	±0.016% of Rdg	125V mV to 600V 40 Hz to 20 kHz
Resistance[1]	0 to 265 MΩ	±(0.003% + 0.8 counts	100Ω to 4.1 MΩ
Options			
Direct Current[1]	0 to 1.28A	±(0.03% + 10 counts)	0 to 16 mA

[1] *Cannot be installed at same time*

Optional Oscilloscope Calibration:

CG5001 Option

Voltage: (Amplitude Mode) Used to calibrate vertical accuracy 40 µV to 200V (1-2-5 steps), ±(0.25% + 1 µV)

Current: (Amplitude Mode) Used to calibrate current probes 1 mA to 100 mA (1-2-5 steps), ±(0.25% + 2 µA)

Edge: (Amplitude Mode) Used to test input amplifiers and attenuators

Low Range: 20 mV to 1V (1-2-5 steps) <1.3 nS risetime with up to ±2% aberrations

High Range: 1.2V to 100V (1-2-5 steps) <100 nS risetime with up to ±2% aberrations

Markers (Timing Mode) Used to calibrate timebases 5s to 10 ns (1-2-5 steps), ±(0.01%)

Slewed Edge (Timing Mode) Used to calibrate very fast timebases 100 ns to 0.4 nS (1-2-5 steps), ±(0.01% + 40 ps)

Pulse Head: Used to test very wide bandwidth vertical amplifiers <200 ps risetime with up to ±3% aberrations

6060B Option

Frequency: 100 kHz to 1050 MHz; 10 Hz resolution

Amplitude: -137 to +13 dBm; 0.1 dB resolution

For details refer to 6060B Synthesized Signal Generator specifications on page 65.

"Performance Enhanced" A123 for DMM Calibration (A123-PE)

The "performance enhanced" A123-PE is the logical extension to the "cost optimized" A123-CO. It has the same high accuracy direct voltage and full capability alternating voltage to provide all the requirements of a top-of-the-line computer-aided calibration workstation. The addition of the 5200A Precision Alternating Voltage Calibrator improves the basic alternating voltage accuracy, extends the frequency range to 1 MHz and increases the volts-hertz product by a factor of 10. It is characterized at precise voltages and frequencies to provide the very best performance for high precision DMMs.

The equipment for the A123-PE is fitted in a dual 48" rack which has sufficient space for all the standard options. These options are the same as those detailed for the A123-CO including the oscilloscope calibration capabilities.

The A123-PE consists of:
All equipment detailed for A123-CO plus:

5200A Precision Alternating Voltage Calibrator
Dual 48" Rack Assembly, Power Distribution and Fans

Options:
Same as those detailed under A123-CO

A123-PE Specifications

Meter Calibration (Sourcing)

Direct Voltage, Resistance, Direct Current and Alternating Current are identical to A123-CO

	Total Range	Best Accuracy For Output Of	
Alternating Voltage	1 mV to 1100V 50 Hz to 50 kHz plus	±(0.018% +20 counts)	125 mV to 110V 50 Hz to 20 kHz
	100 nV to 100V 10 Hz to 1 MHz 10^7 Volts Hertz Factor	±130 ppm 50 Hz to 20 kHz	500 mV to 100V
Optional 5205A	100V to 1100V 10 Hz to 100 kHz	±180 ppm	1000V 50 Hz to 10 kHz

Digital Multimeter (Measuring)
Same as those detailed under A123-CO

Oscilloscope Calibration
Same as those detailed under A123-CO

Prices

Prices for A123 systems start at $50,000 for a "cost optimized" A123-CO for meter calibration. The "performance enhanced" A123-PE complete with options 5205A, 5220A, CG5001, and 6060B is priced at $106,000. For prices on the configuration to meet your specific requirements, please contact your local Sales Representative.

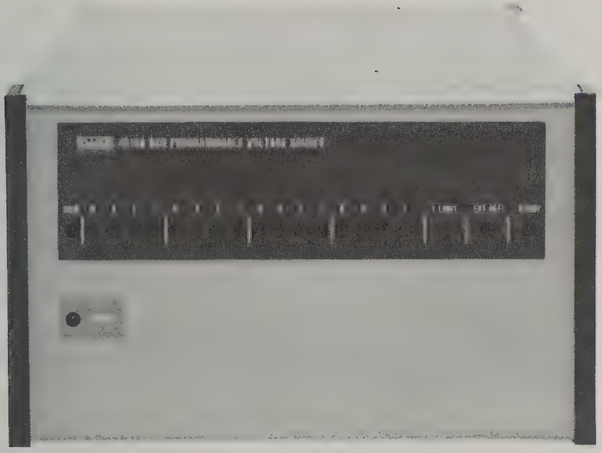
Complete Support

Fluke is the world leader in calibration instrumentation. This world leadership is reflected in the support you receive when you purchase a computer-aided-calibration system from Fluke.

- A123 users can become members of the Fluke Computer-Aided Calibration Users Group. This provides a means of communication among users who exchange calibration procedures or helpful hints on approaches to computer-aided calibration.
- A123 users have access to the extensive library of procedures that have been written for a wide variety of DMM's and oscilloscopes.
- On-site installation by a qualified Fluke technician is included in the price of all A123 systems.
- A full 90-day on-site warranty is standard with all A123 systems.
- On-site or factory training is optionally available through Fluke Technical Service Centers.
- Fluke offers the best service support in the calibration industry. Service contracts are available through Fluke Technical Service Centers for on-site repair.

PROGRAMMABLE POWER SUPPLIES

4200 Series



4210A, ½ Rack Width

4200 Series Power Supplies

- IEEE-488 or parallel interfaces
- BCD or binary 2s complement coding
- Isolated digital control of ac and dc external sources
- Up to 65V at 1 amp or 110V at ½ amp
- Fully guarded
- ±0.01% accuracy
- 100 μV resolution capability
- 30 to 110 μs response time

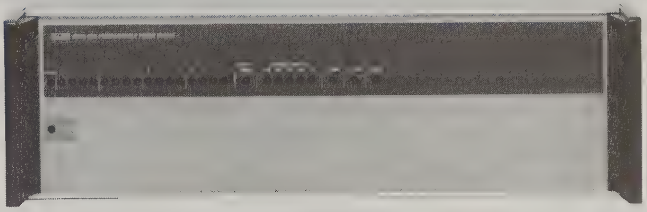
4200 Series Power Supplies

The 4200 Series Programmable Power Sources are more than just precision digital-to-analog converters. They incorporate features that are not available in typical programmable power supplies: speed, accuracy, low programming noise, true current limiting, isolated control logic, output proportional to an external reference voltage.

These power sources may be operated in series or parallel, just like batteries. They will operate with up to 1000 volts between chassis ground and guard (250 volts with IEEE-488 interface). That allows you to use them as a programmable vernier for high voltage power supplies. Current sink capability, coupled with programmable current limits, allows four of the six models to be used as a dynamic load.

Isolated Control Logic Option (-01)

Isolated control logic is parallel BCD for the 4210A, 4250A, and 4270A and 14-bit or 16-bit parallel binary for the 4216A, 4265A, and 4275A and is available as Option -01. However, any of the six models may be ordered with multi-strobe logic (Option -09) or with an interface for compatibility with IEEE Std 488-1978 (Option -05).



4250, Full Rack Width

Multi-Strobe Logic Option (-09)

Allows programming directly from any 16-bit or 18-bit program source with addressing capabilities for up to eight 4200-Series Power Sources. The power sources may be in series as well as parallel. The control lines are electrically isolated from the output.

IEEE-488 Compatibility Option (-05)

The IEEE-488 interface allows the user to program the following functions using command character format: Voltage, current limit, external reference, range, polarity, SRQ response on errors, operate and standby. In addition to the normal command string format of programming, the IEEE-488 interface offers a "Direct Ladder Access" mode of programming. This mode is a 4-byte transfer sequence with limited IEEE-488 error and syntax checking, but with fast output results. The repertoire is SH1, AH1, T6, L4, SR1, DC1, and DT1.

External Reference Option (-03)

Output may be ac as well as dc. And, with Option -03, you have the ability to amplify or attenuate, by digital control, either an ac or dc voltage supplied by an external source. Output polarity matches input polarity. The 3 dB bandwidth is 100 kHz for the 4210A and 4216A, and 30 kHz for the other models.

Current Limit Option (-06)

To protect devices being powered, the output current can be automatically limited to any value between 10% and 110% of maximum output current in 10% steps. Values less than 10% may be selected if an IEEE-488 interface version is purchased. Current is automatically limited at 120% of rated output when Option -06 is not installed.

High Resolution Option (-07)

To be able to program output voltage with 10 times better resolution than normal, Option -07 may be ordered for models 4210A, 4250A, and 4270A. Option -06 cannot be installed at the same time, however.

A4200 Manual Control Unit

For bench operation and calibration the A4200 is available as an accessory. It allows the operator to manually select each control line as well as monitor flag lines available from a power source. To view such characteristics as programming noise, settling time, rise time etc., an automatic mode is provided. When all the bits in any 8-4-2-1 decade are set, the power source will generate a staircase at the analog output which may be examined on an oscilloscope. The A4200 is not compatible with Option -09 or the IEEE-488 Interface Option (-05).

PROGRAMMABLE POWER SUPPLIES

4200 Series

Specifications

	1/2 Rack	Full Rack Width				1/2 Rack
Characteristics	**4210A**	**4250A**	**4270A**	**4265A**	**4275A**	**4216A**
Display Current Range Option -06 Limit Regulation [1]	BCD ±100 mA — 0.001%	BCD ±1A 10% steps* 0.001%	BCD ±0.5A 10% steps* 0.001%	Binary ±1A 10% steps* 0.001%	Binary ±0.5A 10% steps* 0.001%	Binary ±100 mA — 0.001%
Settling Time: Within 0.1% of step Within 0.01% of step	 18 µs 30 µs	 70 µs 100 µs	 80 µs 110 µs	 70 µs 100 µs	 85 µs 110 µs	 18 µs 30 µs
Low Voltage Range						
Voltage Range Resolution W/Option -07	±9.999 1 mV 100 µV	±9.999V 1 mV 100 µV	±9.999V 1 mV 100 µV	±16.383V 1 mV —	±32.7675V 0.5 mV —	±16.383 1 mV —
90-Day Accuracy [2] ±0.01% of output	±100 µV	±100 µV	±100 µV	±100 µV	±160 µV	±100 µV
90-Day Stability [3] ±0.003% of output	±60 µV	±70 µV	±70 µV	±70 µV	±105 µV	±60 µV
Ripple and Noise [4] Programming Noise	300 µV rms 130 mV p-p	500 µV rms 130 mV p-p	500 µV rms 130 mV p-p	500 µV rms 130 mV p-p	500 µV rms 130 mV p-p	300 µV rms 130 mV p-p
High Voltage Range						
Voltage Range Resolution W/Option -07	— — —	±65.00V 10 mV 1 mV	±99.99V 10 mV 1 mV	±65.53V 4 mV —	±110V 2 mV —	— — —
90-Day Accuracy [2] ±0.01% of output	—	±700 µV	±700 µV	+300 µV	+530 µV	—
90-Day Stability [3] ±0.003% of output	—	±490 µV	±490 µV	±210 µV	±370 µV	—
Ripple and Noise [4] Programming Noise	— —	1 mV rms 260 mV p-p	1.2 mV rms 260 mV p-p	1 mV rms 260 mV p-p	1.2 mV rms 260 mV p-p	— —

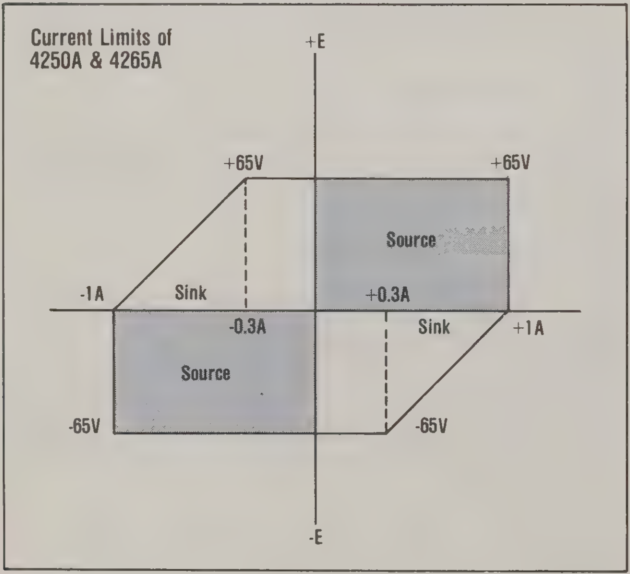
**Also 1% steps to 11% with IEEE-488 interface. Limit at 120% of range without Option -06*

1. Percent of output, no load to full load, ™10% line change

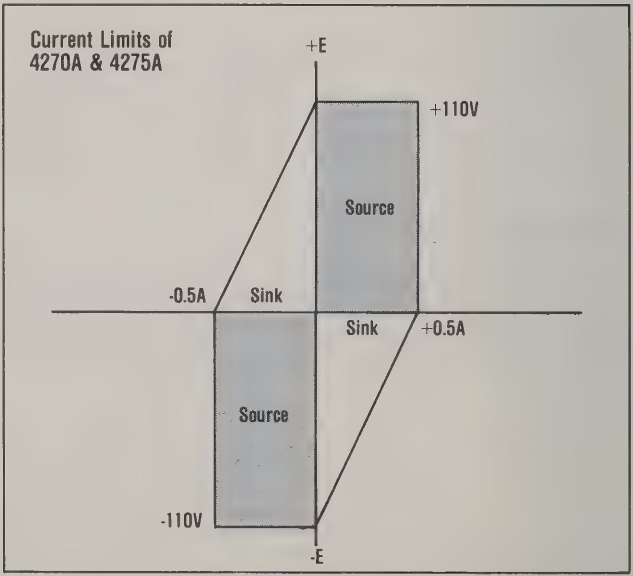
2. 15° C to 35° C

3. At constant line, load, and temperature

4. 10 Hz to 10 MHz bandwidth



Current Limits of 4250A & 4265A



Current Limits of 4270A & 4275A

General Specifications

Shock: 20G, 11 millisecond half-sinewave
Vibration: 4.5G, 10 Hz to 55 Hz
Altitude: ≤10,000 feet, operating; ≤50,000 feet, non-operating
Temperature: 0°C to 50°C operating; -40°C to +75°C non-operating
Power: 115V or 230V ac ±10%, 48 Hz to 62 Hz. 4210A and 4216A 15W; 4250A and 4265A 100W; 4270A and 4275A 200 W
Size
4210A and 4216A: One half 19-inch rack width, 13.3 cm H x 21.6 cm W x 40.9 cm D (5.25 in x 8.5 in x 16.13 in)
Others: Full 19-inch rack width, 13.3 cm H x 43.2 cm W x 49.7 cm D (5.25 in x 17 in x 19.56 in)
Weight
4210A and 4216A: 5.5 kg (12 lb)
Others: 15.9 kg (35 lb)
Warranty Period: One year
Included: Instruction manual, service manual, power cord, mating digital input cable connector, screw terminal outputs. Order Y8021, Y8022, or Y8023 cable separately for Option -05.

Models

	January 1986 prices
4210A* Programmable Power Source, 100 mA	$2755
4216A* Programmable Power Source, 100 mA	2755
4250A* Programmable Power Source, 1A	3960
4265A* Programmable Power Source, 1A	3960
4270A* Programmable Power Source, 500 mA	4305
4275A* Programmable Power Source, 500 mA	4305

**Interface Option -01, -05, or -09 is also required*

Options*

4210A and 4216A	
4200A-01 Isolated Control Logic	520
4200A-03 External Reference	360
4200A-05 Interface for IEEE-488 bus	580
4210A-07 100 μV Resolution (4210A only)	520
4210A-09/BCD Multi-strobe Logic (4210A)	915
4216A-09/B Multi-strobe Logic (4216A)	915
4250A and 4265A	
4200A-01 Isolated Control Logic	520
4200A-03 External Reference	360
4200A-05 Interface for IEEE-488 bus	580
4250A-06 Programmable Current Limit	360
4250A-07 100 μV Resolution (4250A only)	520
4250A-09/BCD Multi-strobe Logic (4250A)	915
4265A-09/B Multi-strobe Logic (4265A)	915
4270A and 4275A	
4200A-01 Isolated Control Logic	520
4200A-03 External Reference	360
4200A-05 Interface for IEEE-488 bus	580
4270A-06 Programmable Current Limit	360
4270A-07 100 μV Resolution (4270A only)	520
4270A-09/BCD Multi-strobe Logic (4270A)	915
4275A-09/B Multi-strobe Logic (4275A)	915

** All options are field-installable. To order, add a "K" to the option number, example 4200A-03K. Contact the Parts Department for field installation of the -07 and -09 options. Order Cable Y8021, Y8022, or Y8023 separately.*

Accessories (Also see page 230)

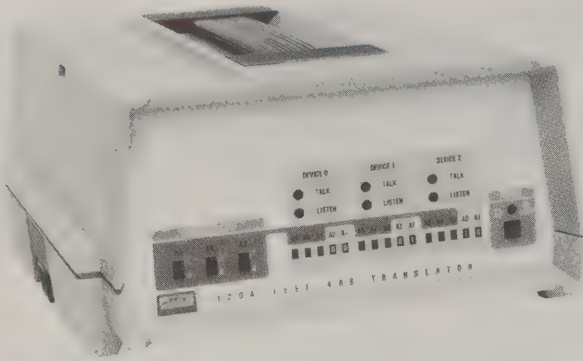
Rack Adapters for 4210A and 4216A	
M05-200-603 5¼", Dual	110
M05-203-601 5¼", Offset	110
M05-203-602 5¼", Centered	110
Rack Adapter for 4250A, 4265A, 4270A, 4275A	
M05-205-600 5¼"	85
Rack Slides for M05-200-603 and M05-205-600	
M00-260-610 18"	105
M00-280-610 24"	110
A4200 Manual Control Unit with Cable	595
4210A-4014 PCB Extender Board	85
4270A-4303 PCB Extender Cable	150
Y8021 1m Cable, for IEEE-488 bus	85
Y8022 2m Cable, for IEEE-488 bus	95
Y8023 4m Cable, for IEEE-488 bus	105

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

IEEE-488 TRANSLATOR

1120A



1120A

1120A IEEE-488 Translator

Fluke's Portable Test Instrumentation (PTI) system puts low cost instruments on the IEEE bus by means of a new concept in instrumentation. The benefit is that you only pay for system capability if and when you need it. And neither size, weight, nor performance of the basic instrument is compromised for system capabilities you may never need. Instead of building interface capabilities into each low cost unit, we have designed a single instrument called the 1120A IEEE-488 Translator to do the interfacing job for you.

The 1120A is the communications link between IEEE Std 488-1978 and a variety of Fluke instruments. Operating between one or more instruments and the IEEE bus, the 1120A converts codes and signals on the bus to corresponding codes and signals compatible with the particular instrument. It passes address and control commands to an instrument or outputs data, or both, depending on the capabilities of the particular instrument being interfaced.

The 1120A is a translator for a number of Fluke instruments including universal counter/timers, communications counters, digital thermometers, frequency synthesizers, and digital voltmeters. Up to three instruments can be interfaced to the bus with a single 1120A, and as many 1120As can be used in a system as necessary.

The 1120A connects instruments to the bus through an optional data output unit in the instrument and a "personality card" in the 1120A. Each personality card is individually addressable and "transparent" to other instruments. Each corresponds to a particular Fluke instrument model and is sold as an option to that instrument or a field-installable kit. The cards simply plug in to an 1120A which provides the necessary power and microprocessor-based circuits for their operation. The 1120A personality cards, accessory cables, and instrument data output units are designed to be easily assembled by the user. As your needs change, you can quickly change cards to accommodate other Fluke instruments. Many of the instruments and cables are sold as Option -521. If so numbered, they will operate directly into a Fluke 2020A (with Option -004) or 2030A Printer without an 1120A IEEE-488 Translator.

Building A System

Instruments that presently operate through the 1120A Translator to work in an IEEE-488 systems are: 2180A, 2190A, 6039A/AZ, 6160B, 7220A, 7250A, 7260A, 7261A, 8600A, 8810A, 8920A, 8921A, and 8922A. Ordering Option -529 with most any of those instruments will get you all the things you need to connect the instrument to an 1120A Translator. However, check the catalog pages pertaining to each instrument to be sure.

For example, if you wanted to connect both a Fluke 7261A Counter and a Fluke 8920A Digital Voltmeter to other instruments on the IEEE-488 bus you could do so by ordering an 1120A Translator and checking the option descriptions for the 7261A and 8920A. You would find you need Option 892XA-529 (for the 8920A) and Option 72XXA-529 (for the 7261A).

Optional 1-meter, 2-meter, or 4-meter cables connect the 1120A Translator to other "bus instruments."

See the instrument index in the front of this catalog for a complete listing of IEEE-compatible instruments.

A17-4 Bit Parallel Interface

A special circuit card may be fitted into an 1120A Translator that converts it into a general purpose translator between IEEE-488 bus systems and bit parallel data systems.

One A17-4 Card handles up to 32 digital inputs and/or outputs and up to three A17-4 cards will fit in one 1120A Translator.

Any, or all, of the 32 bits may be used as input and/or output. However, these bits must be organized in groups of four or eight. BCD, binary and hexadecimal modes may be chosen, or for status outputs any single bit may be set or reset without altering other bits in the binary or hex mode.

The A17-4 can be set to continuously monitor any designated single port (8 or 4 bits). It will then request service whenever any bit of that port, which is enabled by the SRQ mask, changes to a logic True.

The A17-4 has an output strobe line which may be used to trigger or latch external devices when the data on the output lines is avlid. Similar capability is built into the 2400B, 2280A, and the 1722A with Option -002.

For more information ask for Bulletin A0143.

Model

January 1986 prices

1120A IEEE-488 Translator	$550
A17-4 Bit Parallel Interface	on req.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

DIGITAL THERMOMETERS & SYSTEMS

Introduction

Temperature is one of the most commonly measured parameters in today's laboratory and industrial environments. To meet our user's needs for ever-increasing precision in temperature measurements, Fluke has applied its expertise in low level voltage measurement to develop a family of digital thermometers that are demonstrated leaders in quality and accuracy.

The Fluke family of digital thermometers ranges from low cost thermocouple adaptors for handheld multimeters to complete temperature logging systems. You will find that all of the Fluke temperature products are designed to be the highest quality and most accurate thermometers for the price. Industrial applications can now achieve lab accuracy.

Selection Guide

Features	Panel Mount		Portable or Rackmountable							
	2160A	2170A	2165A	2166A	2168A	2175A	2176A	2190A	2180A	2189A
Pt, Ni, Cu Type RTDs	—	—	—	—	—	—	—	—	All	Pt
NBS Type B,E,J,K,R,S,T,C T/Cs*	All	E,J,K,T	All	All	All	E,J,K,T	E,J,K,T	All	—	—
DIN Type J,T T/Cs	No	No	No	No	No	No	No	Both	—	—
Measurement Resolution C or F	1°	0.1°	1°	1°	1°	0.1°	0.1°	0.1°	0.01°	0.01°
Number of Digits	4	4	4	4	4	4	4	5	5	5
Single Alarm Limit	2162A	2162A	—	—	—	—	—	-006	-006	-006
Multiple Alarm Limit	—	—	—	—	—	—	—	Y2002	Y2002	Y2002
Selectable Input Points	1	1	1	10	—	—	10	1	1	1
Multipoint Selector, Manual	2161A	2161A	**	—	**	**	**	Y2001	Y2000	Y2000
Points Per Selector	10	10	**	—	**	**	**	10	10	10
Maximum Points	30	30	**	—	**	**	**	100	100	100
Rechargeable Batteries	—	—	-01	Y2004	Y2004	-01	Y2004	Y2009	Y2009	Y2009
External 12V DC Operation	—	—	—	Yes	Yes	—	Yes	Yes	Yes	Yes
Analog Output Option	-04	-04	-04	-04	-04	-04	-04	-002	-002	-002
Digital Output Option	-02	-02	-02	-02	-02	-02	-02	-002	-002	-002

**Type "C" is not an ANSI/ISA approved designation. It is used to designate Tungsten-5% Rhenium vs. Tungsten-26% Rhenium.*

***Works with 2161A Multipoint Selector except case style is different.*

[1] *Also see 8520A/PRT Precision Thermometry Systems*

Thermometry Product Summary

2160 and 2170 Series: Low-cost, high-accuracy digital thermocouple thermometers in either bench/portable or panel mount styles for applications requiring 1 degree or 0.1 degree resolution.

8520A/PRT: Best accuracy from -200°C to +350°C. A Rosemount 162N Platinum Resistance Thermometer Probe (PRT) and a Fluke 8520A 5½-Digit Precision Multimeter having a built-in, customized linearization curve to match the specific PRT.

2180A, 2189A, and 2190A: Fluke's most accurate and versatile general purpose digital thermometers for RTDs or thermocouples. You may stack and latch each thermometer to a wide range of accessories, including manual multipoints, multiple alarms, a battery pack, and a thermocouple calibrator.

2300A Scanner: Designed to be used with a 2180A or 2190A Digital Thermometer. The 2300A will automatically scan up to 100 points of temperature, using either a 2180A and RTDs or a 2190A and thermocouples. The unit can optionally run under computer control.

Temperature Logging Systems: Choose from four models — two for RTDs and two for thermocouples. These factory-tested systems include a thermometer, scanner, and printer for precision temperature logging that is also portable.

2020A and 2030A Printers: Allow you to log data from a thermometer or a scanner and thermometer. The 2030A permits mX+b math scaling and trend plotting.

TEMPERATURE MEASUREMENT THEORY

Digital Thermocouple Thermometers

Thermocouples are the most widely used temperature sensors. This is due to their simplicity, ruggedness, low cost and wide temperature range. A practical thermocouple consists of two wires made of dissimilar metals which have been joined together at one end (called the measurement junction) and thermally if not physically joined together at the other end (called the reference junction). The low dc voltage that is generated whenever the two junctions are at different temperatures is proportional to both the temperature difference and the absolute temperature of the two junctions.

A practical thermocouple circuit has the measurement junction placed at the point to be measured and the second at a known (reference) temperature. The thermoelectric voltage may be measured by connecting the copper leads of a sensitive voltmeter between the thermocouple wires at the reference junction. The temperature of the measurement junction can be determined by using tables published by the National Bureau of Standards that correspond to the type of thermocouple metals used.

Ice Point Compensation

NBS Thermoelectric Tables are based on a reference junction temperature of 0°C, the Ice Point. This does not mean that the reference junction temperature must be maintained at 0°C; we only need to *know* its temperature to compensate for the difference from 0°C. Because the reference junction is in the measurement instrument and usually operating somewhere near 25°C, its temperature may be measured precisely using a semiconductor sensor. Ice Point compensation data is continuously available and continually applied.

Thermocouple Types

Type J, Iron-Constantan. Range is -210°C to +760°C. Alloy becomes brittle below 0°C. For reducing atmospheres and suitable in vacuum and oxidizing atmospheres. Not for sulphurous atmospheres above 500°C. Color code: White plus, red minus.

Type K, Chromel-Alumel. Range is -270°C to +1370°C. For use in clean oxidizing or inert gas atmospheres. Not for vacuum at high temperatures. Peculiar problem of corrosion in low-oxygen atmospheres. Color code: Yellow plus, red minus.

Type T, Copper-Constantan. Range is -270°C to +400°C. More accurate than Type K in its more limited temperature range. For use in oxidizing reducing, inert gas, or vacuum atmospheres. Not suitable for use under nuclear radiation. Color code: Blue plus, red minus.

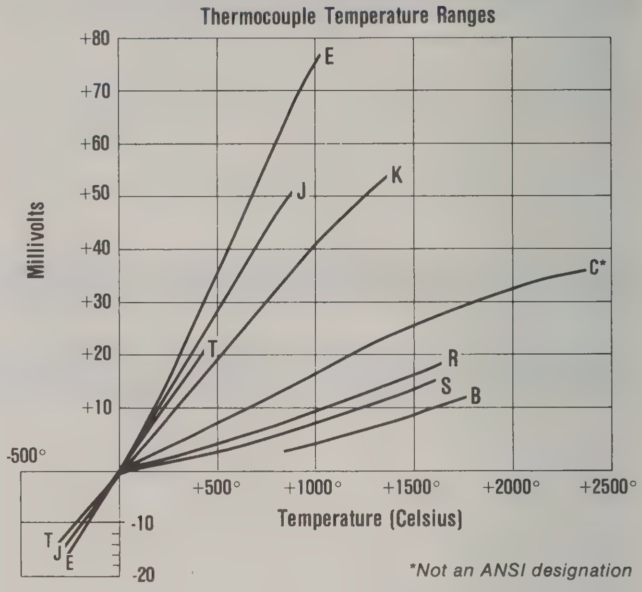
Type E, Chromel-Constantan. Range is -270°C to +1000°C. Highest voltage output per degree. For use in oxidizing or inert gas atmospheres. Not for sulphurous, low-oxygen, or reducing atmospheres or in vacuum at high temperatures. Most applications require protective tube or sheath. Color code: Purple plus, red minus.

Type R & S, Platinum-Rhodium Alloys. Positive material is a platinum-rhodium alloy; negative is pure platinum. Positive material for Type R is 13% rhodium; Type S is 10% rhodium. Range is 0°C to +1760°C. High resistance to oxidation and corrosion but hydrogen, carbon, sulphur, phosphorus, and metal vapors can contaminate. Should generally be used in non-metallic protective tube. Color code: Black plus, red minus.

Type B, Platinum-Rhodium Alloys. Positive is 30% rhodium; negative is 6% rhodium. Range is 0°C to +1820°C. Otherwise like R & S types. Color code: Grey plus, red minus.

Type C, Tungsten-Rhenium Alloys. Range is 0°C to +2350°C. For high temperature measurements. Poor oxidation resistance. Should be used in vacuum, hydrogen, inert gas, or reducing environment.

Thermocouple Linearization


Thermocouple Temperature Ranges

*Not an ANSI designation

The relationship between the temperature of a thermocouple and its generated voltage is very non-linear. Fluke thermometers linearize the measured signal using a segmented curve-fit algorithm. The 2160- and 2170-Series Thermometers use an LSI chip. The 2190A Thermometer uses a microcomputer chip.

Digital RTD Thermometers

A resistance temperature detector (RTD) consists of an element, mounted strain free, having a resistance that varies a known amount as a function of its temperature. An accurate source of current is used to measure its resistance by measuring the voltage-drop across it. The 2180A Digital RTD Thermometer is a very accurate dc voltage measuring instrument that also provides a stable known source of current and has a microcomputer with precise curve-fit algorithms to match several types of RTDs.

Linearization is performed using a segmented, fourth order polynomial curve-fit algorithm in the 2180A Thermometers microcomputer.

Digital Thermometer Accuracy

Any digital thermometer using contemporary analog-to-digital conversion techniques can only be totally characterized for accuracy by a statement that includes the following error terms. We call such a statement about digital thermometers the *Total Instrument Accuracy* specification.

NBS or DIN Curve Conformity: Absolute worst-case deviation over complete sensor span.

Calibration: ±½ digit (resolution) + curve conformity at calibration point.

Span: Expressed as percent of reading, °F/°C. Function of reference voltage temperature coefficient.

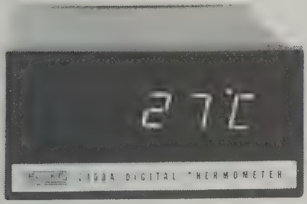
Zero: Temperature coefficient and drift outside auto-zero loop (negligible in Fluke a-d converter).

Reference Junction: Expressed in degrees per degree deviation from 25°C (77°F). Consists of linearity error plus temperature coefficient error. For thermocouples only.

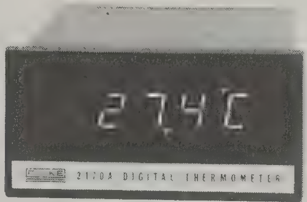
Noise: Inherent instrument electrical noise.

Stability: Expressed in percent of reading (reference voltage change) + absolute error in degrees (reference junction compensation change).

The Fluke *Total Instrument Accuracy* specification includes all of the above error sources and is a direct benefit to a user by providing a clear, concise statement of accuracy in simple terms of °C and °F.



2160A

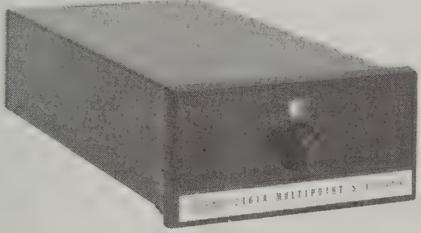


2170A

2160A/2170A Panel-Mount Thermometers

The 2160A and 2170A Thermometers are designed to be mounted in a panel. The panel opening required is a rectangle that is only 4.5 cm high by 9.2 cm wide, conforming to DIN Standard 43700. Both thermometers will indicate temperature in degrees Celsius or degrees Fahrenheit and an internal jumper is used to switch from one scale to the other.

The 2160A has a 1°C or 1°F resolution and uses any one of eight thermocouple types (J,K,T,E,R,S,B, or C). The 2170A has a 0.1°C or 0.1°F resolution and uses any one of four thermocouple types (J,K,T, or E). Both the 2160A and 2170A are physically and electrically compatible with the 2161A Multipoint Selector and the 2162A Digital Limit Comparator.



2161A

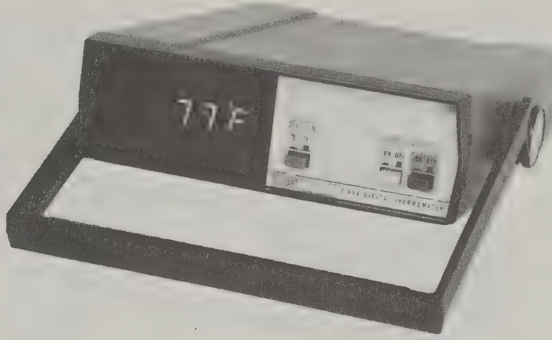
2161A Panel-Mount Multipoint Selector

The Model 2161A Multipoint Selector is a panel-mounting, manually switched selector that allows 1 to 10 thermocouple probes of the same type to function as the input to the 2160A, or 2170A or other thermocouple thermometers. Two or more 2161As can be connected in series for monitoring more than ten inputs.

2162A

2162A Panel-Mount Limit Comparator

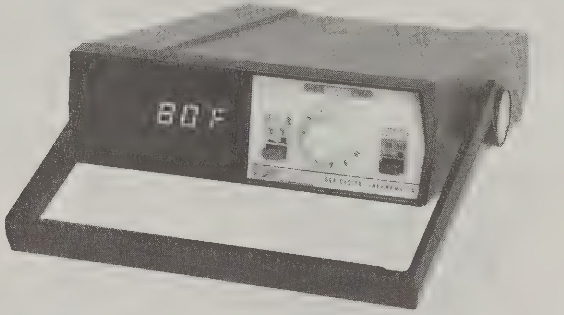
A panel-mounting, single-limit comparator with attached cable and plug compatible with 2160A or 2170A. Front panel thumb-wheel switches allow you to select polarity, four limit digits, and high or low limit. Resolution is ±1°. An out-of-limit reading generates a visual indication and a contact closure. Two 2162As can be connected in parallel for two-limit requirements.



2165A

2165A Digital Thermometer

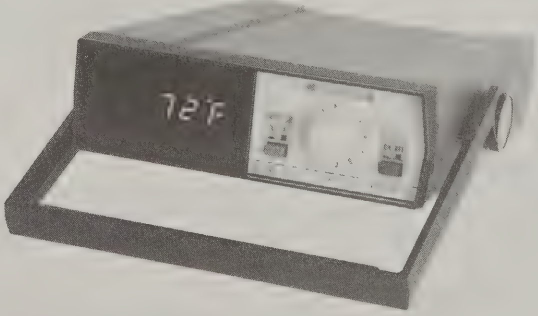
A single-point instrument in a rugged, portable case with specifications identical to the 2160A. It can be equipped with internal rechargeable batteries. Pushbutton controls include power (ON-OFF), temperature scale selection (°F/°C), and battery charge (ON-OFF). Resolution is 1°F or 1°C.



2166A

2166A Multipoint Digital Thermometer

The 2166A is the same basic bench-type instrument as the 2165A but with the capability for monitoring up to 10 thermocouples of the same type. Thermocouple channel selection is by a 10-position front panel rotary switch. Power is either line voltage or external 12V dc (Y2004 Battery Pack has rechargeable batteries). Resolution is 1°F or 1°C.

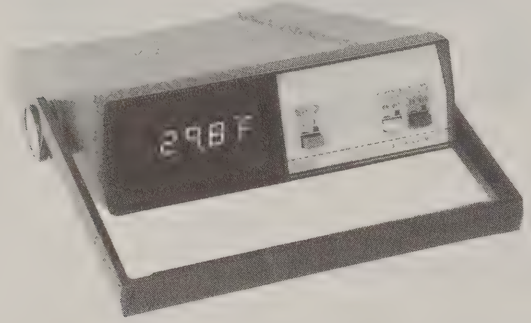


2168A

2168A Multitype Digital Thermometer

The 2168A is a portable, single-point instrument capable of accepting the output from any one of eight thermocouple types.

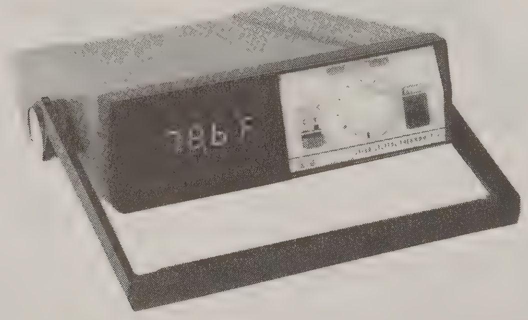
Performance specifications are identical to the 2160A for each thermocouple type. Front panel controls include pushbutton power switch (ON-OFF) and temperature scale selection (°F/°C), plus an eight-position rotary switch for selecting thermocouple type. Power is either line voltage or external 12V dc (with Y2004 Carrying Case). Resolution is 1°F or 1°C.



2175A

2175A Digital Thermometer

The 2175A is a single-point instrument in a rugged, portable bench-mount case with the same specifications as the 2170A. It can be equipped with internal rechargeable batteries. Pushbutton controls include a power switch (ON-OFF), temperature scale selection (°F/°C), and battery charge. Resolution is 0.1°F or 0.1°C.



2176A

2176A Digital Thermometer

The 2176A is the same basic bench-type instrument as the 2175A but with the additional capability of monitoring up to 10 thermocouples (of the same type). Thermocouple channel selection is by means of a 10-position front panel rotary switch. Power is either line voltage or external 12V dc (with Y2004 Battery Pack). Resolution is 0.1°F or 0.1°C.

Option Specifications

Rechargeable Batteries (-01)

Used in Models 2165A and 2175A for portable operations, and provides a continuous operating time of 8 hours. The internal batteries are recharged from line power in either trickle or full charge mode. They are field-installable at a later date.

Digital Output Unit (-02)

A field-installable option that provides a parallel BCD digital output equivalent to the displayed measurement data. Output data is solicited by an External Trigger and valid data is insured by Busy and Not Busy outputs. Output is fully buffered TTL/DTL compatible, isolated to 300V. A 6-foot ribbon cable and connector are included. Operates only when powered by AC line.

Analog Output Unit (-04)

A field-installable assembly which provides an output voltage of 1 mV per degree (Celsius or Fahrenheit). Automatic polarity sensing is provided so that the polarity of the output voltage agrees with the displayed temperature. The output voltage is isolated from the input and referenced to the low terminal of the external voltmeter, strip-chart recorder, etc. A 6-foot pair of wires and connector are included. Accuracy is ±.5% of reading ±1 mV. Operates only when powered by AC line.

Specifications

Compatible Thermocouple Types:
2160A Series: J, K, T, E, R, S, B, C
2170A Series: J, K, T, E

Measurement Method: Dual-slope integration over a 100 ms period

Drift: None, automatic zero correction

Reading Rate: 2.5 readings per second

Conversion °C to °F: Jumper-selectable in panel-mount models. Switch-selectable on portable models

Input Connections: Screw terminals on isothermal connector

Input Circuit: Two-wire, isolated

Input Impedance: 100 MΩ

Input Current: 500 pA

Source Impedance: 5 kΩ (5 kΩ causes <0.2°C error with K thermocouple)

Maximum Input Voltage: 400V dc or peak ac continuously, between inputs or either input and ground

Maximum Common Mode Voltage: 400V dc or peak ac

Common Mode Rejection: ⩾120 dB at 50, 60, 400 Hz ±0.1% with 1 kΩ source impedance unbalance

Normal Mode Rejection: ⩾60 dB at 50, 60, 400 Hz ±0.1%

Overload: Display flashes when input voltage exceeds full-scale temperature range

Open Input: Display flashes to indicate open at input terminals

Response Time: ⩽2.0 second to rated accuracy

2160A Series Accuracy Specifications

Thermocouple Type	Applicable Temperature Range °C	Maximum Error** (±°C)			Applicable Temperature Range °F	Maximum Error** (±°F)		
		Calibration Accuracy	90 Days 20 to 30°C	1 Year 15 to 35°C		Calibration Accuracy	90 Days 68 to 86°F	1 Year 59 to 95°F
J	-200 to 0 0 to 778	1 1	1.5 1	1.5 1.5	-328 to 32 32 to 1432	1.5 1	2 1.5	2.5 2
K	-200 to 0 0 to 1356	1 1	1.5 1.5	2 2	-328 to 32 32 to 2472	2 1.5	2.5 2.5	3 3
T	-200 to 0 0 to 400	1 1	1.5 1	2 1	-328 to 32 32 to 752	1.5 1	2 1.5	3.5 2
E	-200 to 0 0 to 1000	1 1	1.5 1	2 1.5	-328 to 32 32 to 1832	1.5 1	2 2	3.5 2.5
R	0 to 1778	1.5	2.5	3	32 to 3232	2	4	5
S	0 to 1778	1.5	2	3	32 to 3232	2	3.5	4.5
B	533 to 1844	1.5	2	2.5	992 to 3352	2	3.5	4.5
C*	0 to 2328	2.5	3.5	4	32 to 3999	4	6	6.5

** C designates Tungsten-5% Rhenium vs. Tungsten-26% Rhenium*

*** Max. error includes NBS conformity, calibration, span, zero, reference junction, noise and stability, but not thermocouple errors. Add 0.1° C or 0.2° F for Model 2166A.*

2170A Series Accuracy Specifications

Thermocouple Type	Applicable Temperature Range °C	Maximum Error* (±°C)			Applicable Temperature Range °F	Maximum Error* (±°F)		
		Calibration Accuracy	90 Days 20 to 30°C	1 Year 15 to 35°C		Calibration Accuracy	90 Days 68 to 86°F	1 Year 59 to 95°F
J	-99.9 to 0	0.5	1	1.2	-99.9 to 32	0.9	1.6	2.1
	0 to 777.9	0.4	0.7	1.1	32 to 999.9	0.7	1.2	1.6
K	-99.9 to 0	0.7	1.2	1.5	-99.9 to 32	1.1	2.0	2.6
	0 to 999.9	0.5	1.1	1.4	32 to 999.9	1	1.4	1.8
T	-99.9 to 0	0.6	1	1.6	-99.9 to 32	0.9	1.7	2.9
	0 to 400	0.4	0.6	0.9	32 to 752	0.6	1	1.5
E	-99.9 to 0	0.6	1	1.7	-99.9 to 32	0.9	1.7	3.0
	0 to 999.9	0.5	1	1.4	32 to 999.9	0.8	1.3	1.8

* *Max. error includes NBS conformity, calibration, span, zero, reference junction, noise and stability, but not thermocouple errors. Add 0.1°C and 0.2°F for Model 2176A.*

External DC Source: 2166A, 2168A, and 2176A 11 to 15V dc at 400 mA. Y2004 recommended
Size: (2165A, 2166A, 2168A, 2175A and 2176A), 6.4 cm H x 21.7 cm W x 25.2 cm D (2.52 in H x 8.55 in W x 9.9 in D)
Size: (2160A and 2170A) conforms to DIN standard 43700. 4.8 cm H x 9.6 cm W x 20.5 cm D (1.88 in H x 3.78 in W x 8.05 in D). Panel cutout is 9.2 cm x 4.5 cm (3.62 in x 1.77 in)

Type of Display: LED
Shock and Vibration: Meets requirements of MIL-Std-810
Ambient Temperature: 0°C to 50°C, operating; -40°C to 60°C with batteries, -40° to 75°C without batteries, non-operating
Relative Humidity: ≤90% from 0°C to 35°C, ≤80% to 50°C, non-condensing
Line Operation: 115V ac ±10%, 50 to 440 Hz, 8W (bench), 4W (panel). 100V ac and 230V ac versions are also available
Battery Operation: Option -01 for the 2165A and 2175A operates eight hours on a full charge. Y2004 Battery Pack for 2166A, 2168A, and 2176A operates six hours on a full charge, typically
Weight
2165A and 2175A: 1.19 kg (2.63 lb) without batteries, 1.79 kg (3.95 lb) with batteries
2166A, 2168A, 2176A: 1.35 kg (3 lb)
2160A, 2170A: 0.74 kg (1.63 lb)
Warranty Period: One year
Included: Instruction manual, power cord. Thermocouple or thermocouple probe not included

Models

January 1986 prices

2160A*	Thermometer (panel-mount)	$440
2161A	Multipoint Selector (panel-mount)	200
2162A	Digital Limit Comparator (panel-mount)	370
2165A*	Thermometer	575
2166A*	Thermometer (10 points)	680
2168A	Thermometer (8 types)	810
2170A*	Thermometer (panel-mount)	480
2175A*	Thermometer	675
2176A*	Thermometer (10 points)	800

* *Specify thermocouple type to be used. Thermocouples or probes not included.*

Options

2165A-01*	Rechargeable Batteries	95
2160A-02**	Digital Output (w/cable)	180
2160A-04**	Analog Output (w/cable)	235

**For 2165A and 2175A only*
***Mutually exclusive*

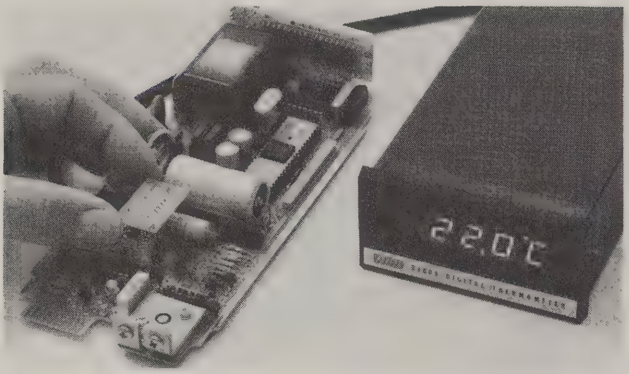
Accessories (Also see page 230)

See next page.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

2160A/2170A Series Thermometers . . . Available through Distributors (See page 248)



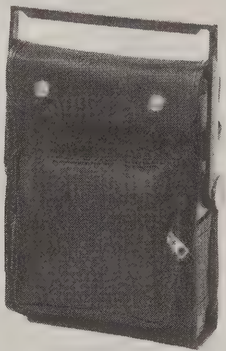
Thermocouple Type Conversion Kits

Your 2160- or 2170-Series Digital Thermometer may be equipped to work with only one type of thermocouple at a time. But it is very simple to convert it to be used with a different type thermocouple with an inexpensive conversion kit. Section II of your instruction manual tells how.

A conversion kit for a J,K,T, or E type thermocouple may be installed in any 2160- or 2170-Series Thermometer. In addition, a kit for a type R,S,B, or C may be installed in 2160 Series (but not the 2170 Series).

NBS Type	Conversion Kit No.	NBS Type	Conversion Kit No.
J	2160A-7016 $35	R	2160A-7012 $35
K	2160A-7017 35	S	2160A-7013 35
T	2160A-7018 35	B	2160A-7014 35
E	2160A-7019 35	C	2160A-7015 35

Y2004



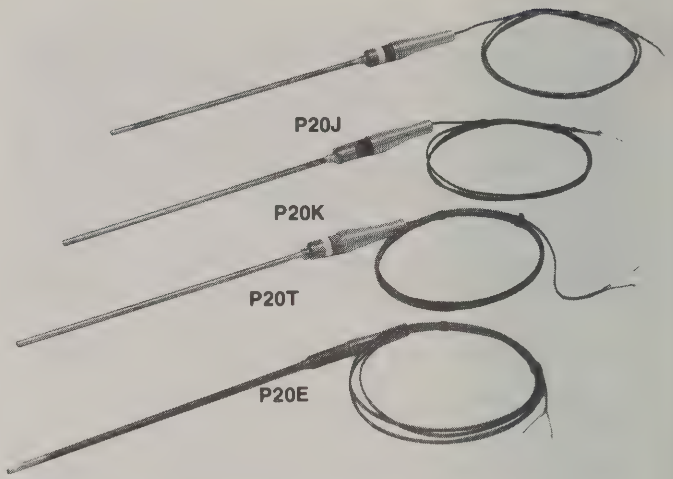
Y2005

Y2004 & Y2005 Case and Battery Pack

The Y2004 consists of a case, 12-volt battery pack, and charger for use with the 2166A, 2168A, and 2176A. The Y2005 is a case only for any bench model 2160- or 2170-Series Thermometer. The Y2004 is especially recommended for the 2166A, 2168A, and 2176A Digital Thermometers because those models are not available with a self-contained rechargeable battery pack but have external 12-volt power connectors.

Typical operating time with batteries having a full charge is six hours. Recharge time at 25°C is approximately 15 hours.

Y2004 Case/Battery Pack & Charger	$195
Y2005 Case	45

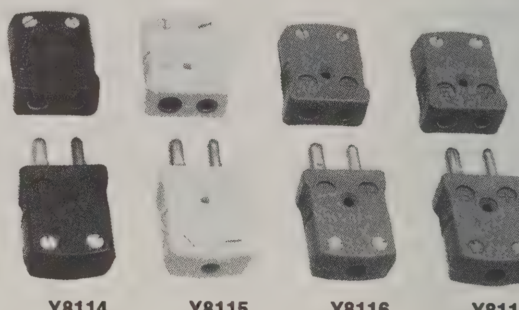


P20-Series Thermocouple Probes

These probes are ANSI Standard accuracy general purpose immersion type probes. They have sheaths 6-inches long by 1/8-inch diameter made of INCONEL.

The thermocouple lead wire is three feet long and its insulation will withstand temperatures up to 480°C continually. Inside the sheath, the wires are insulated with magnesium oxide but are grounded to the sheath at the junction. They are particularly intended for use with Fluke 2190A Digital Thermometers and the 2160- and 2170-Series Digital Thermometers.

Type	Useful Range
P20J $60	-150° to 875°C
P20K 60	-150° to 1260°C
P20T 60	-150° to 400°C
P20E 60	-270° to 1000°C

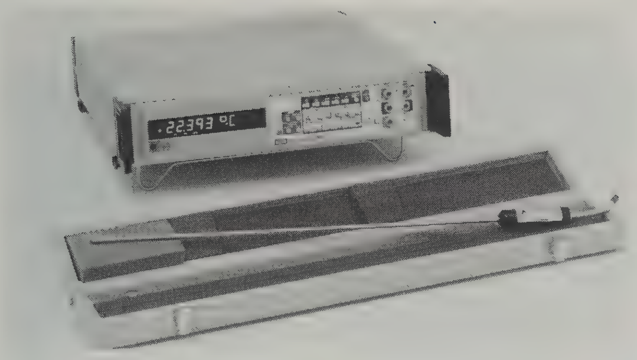


Thermocouple Probe Extender Connectors

Matching thermocouple connectors should be used to extend length of leads when using thermocouple probes. Connectors and 100-foot lengths of #20 AWG thermocouple wire are available. Connectors are made of thermocouple material and should match the type of thermocouple wire.

NBS Type	Probe Type	Mating Connectors	Thermocouple Wire (100 ft)
J	P20J	Y8114 $15	Y8110 $65
K	P20K	Y8115 15	Y8111 110
T	P20T	Y8116 15	Y8112 110
E	P20E	Y8117 15	Y8113 110

8520A/PRT



8520A/PRT

Precision — with RTDs

- -200°C to +350°C (IPTS 68) range
- ±0.010°C accuracy -100°C to +100°C
- 0.001°C resolution
- Reading storage memory
- IEEE-488 interface
- Onboard computational programs
- Full DMM capability

The 8520A/PRT is a temperature measurement system consisting of a Rosemount® 162N Platinum Resistance Thermometer (PRT) and a Fluke 8520A 5½-Digit Precision Digital Multimeter. The 8520A contains a built-in linearization program customized to match the calibration curve of the specific PRT supplied. Temperature is indicated directly in either °C, °F or K with 0.001 degree resolution.

The system provides a fast, low-cost way of making extremely accurate temperature measurements, or calibrating temperature measurement instruments, in the range of -200°C to +350°C. Systems using four-terminal resistance bridges are much more time-consuming to use, require greater expertise, are limited in their applications, and are far more costly.

Measurements are repeated approximately once per second, making it possible to detect and track fast temperature changes, something impractical to try to do with balance bridges.

162N PRT Characteristics

All PRTs exhibit hysteresis during temperature cycling, as with going from room temperature to boiling and back. The 162N has a hysteresis of less than 0.001% of the temperature span. That is less than 1 mK (0.001°C) for a 100°C span, less than 6 mK for the entire thermometer range. This quality is not achievable in any industrial PRT.

Errors due to a change in ice-point resistance can be detected using a standard 100-ohm resistor (supplied), and the change can be compensated easily by changing the gain factor in a memory register of the 8520A. Such compensation is completely effective near 0°C, least effective near -110°C and +240°C, but predictable as a worst-case error at all temperatures within the range of -200°C to +350°C.

8520A Characteristics

The 8520A Digital Multimeter is compatible with IEEE-488 instrument systems and has both built-in and optional math power for a wide range of R&D and ATE applications other than temperature measurement and calibration. See page 15 for more information.

Rosemount® is a trademark of Rosemount, Inc.

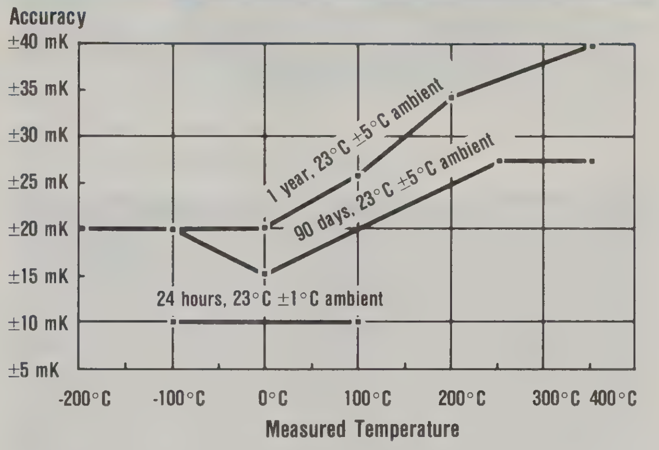
Accuracy

The temperature measurement accuracy of the 8520A/PRT system is shown graphically in the accompanying chart. Because accuracy depends on the stability characteristics of the 8520A as a function of both ambient temperature and time, 24-hour, 90-day, and 1-year accuracy curves are shown. The kind of accuracy you need will determine how often the 8520A should be calibrated.

The stability characteristics of the PRT are also very important and are influenced by time, how carefully it is used, and the kind of use it gets.

The 162N Probe is calibrated in liquid baths. No significant error due to self-heating will occur when measuring the temperature of liquids. A +12 mK error should be expected when measuring the temperature of gases.

Specifications



Probe Sheath: INCONEL-X750™, 5.6 mm (0.219 in) diameter, 48 cm (19 in) length
Connector: Mates with 8520A/PRT
Power: 100, 120, 220, or 240V ac, ±10%, 50 to 60 Hz, ≤50W
Size: 8.9 cm H x 47.7 cm L x 43.2 cm W (3½ in H x 18 in L x 17 in W)
Weight: 9.56 kg (21 lb)

Model

January 1986 prices

8520A/PRT	$6630

Option

8520A-010 Extended Software Package	500

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

DIGITAL THERMOMETERS

2180A/2189A/2190A TemPak Series

2189A Thermometry System

2180A/2189A/2190A

- 0.01° resolution for the 2180A and 2189A and 0.1° resolution for the 2190A
- Capable of running off of 12V dc or ac line power
- Designed to be integrated with a wide variety of instruments and accessories through an integral latching system
- °C or °F is selectable via a front panel switch
- A full five digit LED display
- Analog and digital (RS-232-C or IEEE-488) output option is available
- The limits option allows peak and valley memory, alarms and delta
- The 2189A consists of a 2180A and a matched platinum RTD probe for greater accuracy
- Six different RTD types are switch selectable. Four platinum, one nickel, one copper (2180A only)
- Ten different thermocouple linearizations are supported including two DIN standards (2190A only)

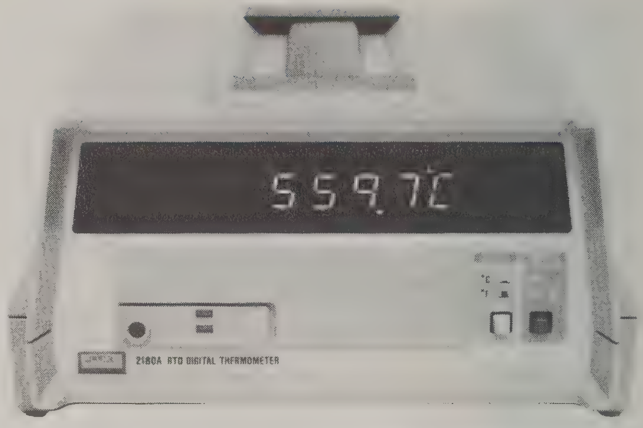
Fluke's most accurate and versatile general purpose digital thermometers are the 2180A and 2189A for RTDs and the 2190A for thermocouples. State-of-the-art accuracy teams with a large family of options and accessories to let you make precision temperature measurements in the lab or out in the field.

The 2180A RTD Digital Thermometer lets you switch-select one of six different types of RTDs, four platinum, one nickel, and one copper. Resolution is 0.01°.

The 2189A Thermometry System consists of a 2180A that is factory-matched to a precision Y2039 Platinum RTD Probe.

The 2190A Thermocouple Digital Thermometer supports ten different thermocouple types, including two that comply to European DIN standards. Resolution is 0.1°. Take your choice from three different standard combinations of thermocouple types.

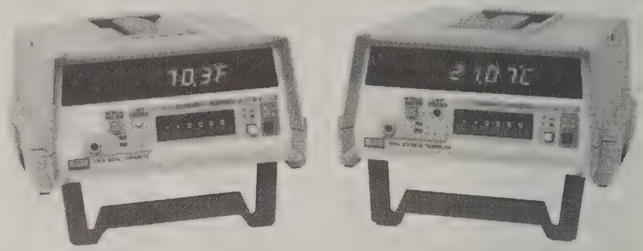
Each thermometer features a bright, high resolution LED display with pushbutton selection of Fahrenheit or Celsius readings. Each is capable of being run from either ac line power or external 12V dc, for field portability.



2180A without Option -006

Output Option -002, -004 and Limits Option -006 are usable with any of the three thermometers. Other accessory items electronically connect and stack and latch to the 2180A or 2190A. These include manual multipoints, multiple alarms, a battery pack, and a thermocouple thermometer calibrator. Some are also practical to use with the 2189A.

For automatic scanning, see the section on the 2300A Scanner. A 2020A or 2030A Printer allows you to permanently store data when used with a 2180A or 2190A configured with an output option. Portable temperature logging is available with the factory-tested Temperature Logging Systems — 2382A, 2383A, 2392A, or 2393A.



2190A/2180A with Option -006

Limits Option (-006)

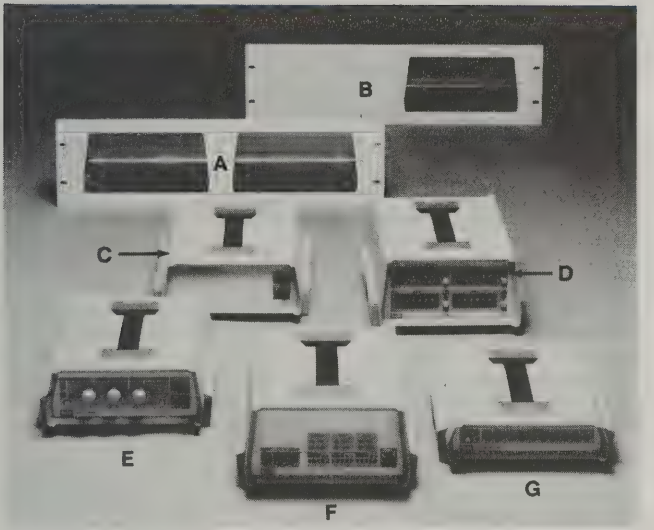
This option adds three powerful functions to the 2180A and 2190A Thermometers: Alarms, Peak Memory, and Delta. The Alarms function lights an indicator and closes a relay to activate external devices whenever a preset maximum or minimum set-point is exceeded. Peak Memory stores the highest and lowest temperature readings for later recall. And Delta automatically subtracts a thumbwheel setting from the actual measurement and displays the difference.

IEEE-488 Option (-004)

NEW

The 21X0-004 is an IEEE-488 output option for the 2180A, 2189A and 2190A thermometers. This option mounts within the thermometer in the same location as the 21X0A-002. Readings are taken in response to an SRQ from the option by an IEEE-488 controller. This interface option does not include analog output capability.

A Family of Accessories

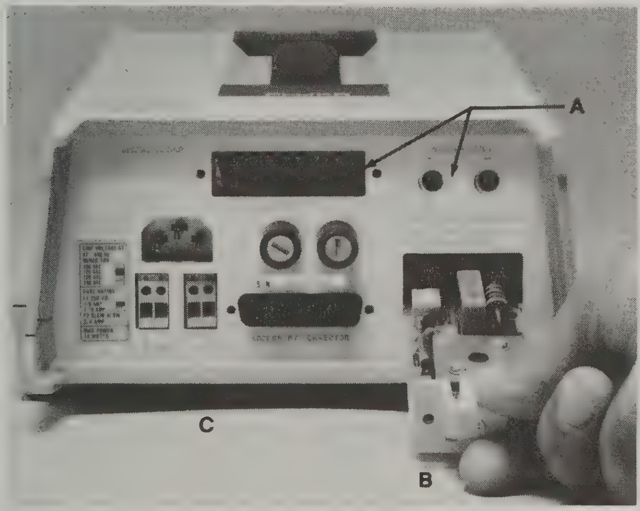


A — Y2001 *Multipoint*
B — Y2010 *Rack Adapter*
C — Y2009 *Battery Pack*
D — Y2002 *Alarms Output*
E — Y2003 *Calibrator*
F — 1120A *Translator*
G — Y2000 *Multipoint*

Output Option (-002)

For recording temperature measurements with a 2180A or 2190A, you can get Output Option -002. It provides both an analog output for chart recorders and a digital output for printers or computers, and may be installed in the field. The digital output is available in four forms, depending on connector pins and cabling used: Parallel ASCII, RS-232-C, TTY current loop, and IEEE-488 (using the Fluke 1120A Translator). The Y2026B RS-232-C Cable Adapter is available to convert the 36-pin PTI connector on the option to a standard 25-pin RS-232-C connector, or the user can wire his own cable to the connector provided.

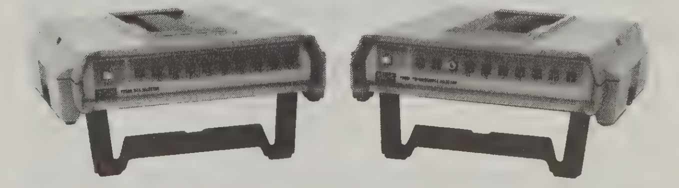
Option -002 is required when the thermometer is being used with a Fluke 2020A-004 or 2030A Printer unless a 2300A Scanner is used.



Rear view of 2190A showing the **(A)** *Output Option -002 Connector,* **(B)** *Y2030 Thermocouple Input Module, and* **(C)** *Limits Option -006 Relay Output.*

Multipoint Selector (Y2000 & Y2001)

The Y2000 RTD Multipoint Selector (for the 2180A) and the Y2001 Thermocouple Multipoint Selector (for the 2190A) increase the number of points your thermometer can monitor. Connect up to ten sensors to each multipoint selector. Cascade up to ten multipoint selectors for up to 100 measurement points — all using a single 2180A or 2190A Thermometer. Both units have ten pushbuttons to easily access a specific measurement point. To measure or monitor more than one type of RTD or thermocouple, take advantage of internal switching. This allows you to monitor five sensors of one type, five of another. With Output Option -002 or -004 installed, the channel number is sent to your printer or computer, too.



Y2000 **Y2001**

Multiple Limits and Alarms (Y2002)

The Y2002 Alarms Output accessory uses four independent comparator circuits for on/off control as well as alarms. Four sets of thumbwheel switches select a high- or low-limit mode, polarity, and the actual limit value. Each comparator circuit signals out-of-limit conditions via an LED and a reed relay (latching or non-latching).

Thermometer Calibration (Y2003)

The Y2003 Thermometer Calibrator and 2190A Digital Thermocouple Thermometer can be used together to check the accuracy of a thermocouple or millivolt-measuring or recording instrument.

Accurate and completely portable, the Y2003-2190A combination provides a variable voltage output from -10 mV to +90 mV. The output voltage simulates a thermocouple output, so that the reading on the 2190A Thermometer can be compared with a corresponding reading on any other thermocouple thermometer, either analog or digital. In addition, the Y2003 and 2190A can be used to calibrate millivolt chart recorders and digital or analog indicators measuring to 90 mV. Besides being used as a portable calibration system, the Y2003 can be used as a battery pack for the 2190A.

The 2190A/Y2003 Portable Calibration System

DIGITAL THERMOMETERS

2180A/2189A/2190A TemPak Series

Battery Pack (Y2009)

The Y2009 Battery Pack is a rechargeable, self-contained 12V dc nickel-cadmium supply for up to five hours of continuous operation. An indicator light tells you when the batteries are low, while an automatic out-off prevents damage to the cells from excessive discharge.

IEEE-488 Bus Translator (1120A)

The Fluke 1120A Translator configured with Option 2XXXA-522 provides a link to the IEEE-488 bus. Connect either a 2180A or a 2190A to the 1120A and you'll have a way of converting between either RS-232-C or IEEE-488. See page 150 and following sections for more information.

Specifications

2190A Thermocouple Thermometer Specifications

Thermocouple Types: Five, switch selectable. Which thermocouple types depends on your choice of microcomputer type. See Accuracy chart below

2190A Accuracy*

Thermocouples		Maximum Error*					
		±Degrees C			±Degrees F		
Type	Applicable Portion of Temperature Range °C	At Cal	90 Days 20°C to 30°C	1 Year 15°C to 35°C	At Cal	90 Days 68°F to 86°F	1 Year 59°F to 95°F
Type 1							
J	-128 to 0	0.18	0.19	0.21	0.20	0.23	0.26
	0 to 900	0.18	0.31	0.36	0.20	0.47	0.58
K	-132 to 0	0.18	0.19	0.21	0.30	0.33	0.37
	0 to 1350	0.18	0.39	0.47	0.30	0.72	0.87
T	-243 to 0	0.18	0.20	0.22	0.30	0.35	0.39
	0 to 400	0.18	0.22	0.25	0.30	0.41	0.46
R	0 to 1708	0.31	0.59	0.70	0.47	1.01	1.20
C**	0 to 2471	0.18	0.60	0.75	0.30	1.11	1.37
Type 2							
J	-128 to 0	0.18	0.19	0.21	0.20	0.23	0.26
	0 to 900	0.18	0.31	0.36	0.20	0.47	0.58
K	-132 to 0	0.18	0.19	0.21	0.30	0.33	0.37
	0 to 1350	0.18	0.39	0.47	0.30	0.72	0.87
E	-252 to 0	0.18	0.20	0.22	0.30	0.35	0.40
	0 to 1000	0.18	0.33	0.39	0.30	0.61	0.72
R	0 to 1708	0.31	0.59	0.70	0.47	1.01	1.20
S	0 to 1685	0.22	0.50	0.60	0.38	0.92	1.10
Type 3							
J	-100 to 0	0.18	0.19	0.20	0.30	0.32	0.36
DIN***	0 to 760	0.18	0.28	0.33	0.30	0.52	0.61
K	-50 to 0	0.18	0.18	0.20	0.20	0.22	0.25
	0 to 1372	0.18	0.39	0.48	0.20	0.63	0.78
T	-200 to 0	0.18	0.20	0.21	0.30	0.34	0.38
DIN***	0 to 400	0.18	0.22	0.25	0.30	0.41	0.46
B	420 to 1815	0.21	0.52	0.62	0.37	0.95	1.15
R	140 to 1700	0.18	0.46	0.46	0.20	0.74	0.93

** Total instrument accuracy. Does not include Thermocouple errors*

*** C designates Tungsten-5% Rhenium vs. Tungsten-26% Rhenium.*

**** DIN is a European Standard.*

Resolution: 0.1°C, °F

Input Connection: 2 wires on screw terminal isothermal block

Max Source Impedance: 2 kΩ

Overrange Detection: Flashing display

Open Circuit Detection: Source impedance of 3 kΩ or more causes a flashing "OC"

2180A RTD Thermometer Specifications

RTD Types: 100Ω Pt, 385 (DIN), 390,3916, or 392; 100Ω Ni (DIN); 10Ω Cu; 0 to 999Ω resistance — switch-selectable

Resolution: 100Ω Pt RTDs: 0.01°, autoranging to 0.1° above 204°C; 100Ω Ni RTDs: 0.01°, autoranging to 0.1° above 93°C; 10Ω Cu RTDs: 0.1°

Input Connection: 4-wire screw terminals. Terminals accept 3-wire and 2-wire RTDs at reduced accuracy

RTD Matching: User-performed potentiometer adjustment matches the 2180A to user's RTD to compensate for variations in lead length and resistance at 0°C

Lead Resistance: 4-wire: 200Ω max per lead for both 100Ω and 10Ω RTDs; 3-wire: 2Ω max per lead for 100Ω RTDs, 0.18Ω max per lead for 10Ω RTDs; 2-wire: 0.9Ω max per lead for 100Ω RTDs, 0.09Ω max per lead for 10Ω RTDs

Lead Resistance Error: 4-wire: no error; 3-wire 100Ω RTDs: 0.012° per degree per ohm; 3-wire 10Ω RTDs: 0.12° per degree per ohm; 2-wire 100Ω RTDs: 0.025° per degree per ohm; 2-wire 10Ω RTDs: 0.25° per degree per ohm

2180A Linearizations (Type 2)*

RTD Type	Linearization Coefficients
100Ω 385 Pt	DIN** 43760 Table
100Ω 390 Pt	ALPHA* = 0.0038994 DELTA* = 1.494 A4* = -0.265668×10^{-4} C4* = $-0.205984 \times 10^{-11}$
100Ω 3916 Pt	ALPHA* = 0.003916 DELTA* = 1.505 A4* = -0.099668×10^{-5} C4* = $-0.271142 \times 10^{-12}$
100Ω 392 Pt	ALPHA* = 0.0039221 DELTA* = 1.493 A4* = -0.38668×10^{-5} C4* = $+0.192912 \times 10^{-13}$
100Ω 617 Ni	DIN** 43760 Table
10Ω*** Cu	R0 = 9.042 Ohms R25 = 10.005 Ohms ALPHA = 0.004260

** See IPTS 68 equations in NBS Monograph 126. Type 1 no longer available.*

*** European Standard.*

**** Contact factory for information on the 2180A/AT for 10 ohm, 3 wire applications*

DIGITAL THERMOMETERS

2180A/2189A/2190A TemPak Series

2180A Accuracy (Type 2)*

RTDs		Maximum Error*					
		±Degrees C			±Degrees F		
Type	Applicable Portion of Temperature Range °C	At Cal	90 Days 20°C to 30°C	1 Year 15°C to 35°C	At Cal	90 Days 68°F to 86°F	1 Year 59°F to 95°F
	-190 to 0	0.043	0.089	0.112	0.076	0.161	0.203
100Ω	0 to 204	0.043	0.132	0.173	0.076	0.239	0.314
385	-190 to 0	0.11	0.12	0.14	0.18	0.21	0.24
Pt	0 to 750	0.11	0.26	0.37	0.18	0.46	0.62
	-200 to 0	0.009	0.055	0.078	0.015	0.100	0.142
100Ω	0 to 204	0.009	0.098	0.139	0.015	0.177	0.252
390	-200 to 0	0.08	0.10	0.11	0.13	0.16	0.19
Pt	0 to 750	0.08	0.23	0.32	0.13	0.41	0.57
	-200 to 0	0.040	0.086	0.109	0.071	0.156	0.198
100Ω	0 to 204	0.040	0.13	0.171	0.071	0.234	0.309
3916	-200 to 0	0.11	0.12	0.14	0.17	0.21	0.24
Pt	0 to 750	0.10	0.26	0.34	0.17	0.46	0.62
	-200 to 0	0.008	0.055	0.078	0.014	0.099	0.141
100Ω	0 to 204	0.009	0.098	0.139	0.014	0.177	0.252
392	-200 to 0	0.08	0.10	0.11	0.12	0.16	0.19
Pt	0 to 750	0.08	0.23	0.32	0.12	0.41	0.57
	-60 to 0	0.129	0.157	0.172	0.230	0.282	0.308
100Ω	0 to 93	0.129	0.176	0.199	0.231	0.317	0.359
617	-60 to 0	0.19	0.20	0.21	0.33	0.35	0.35
Ni	0 to 177	0.19	0.22	0.25	0.33	0.39	0.44
10Ω	-75 to 0	0.16	0.18	0.19	0.27	0.31	0.34
Cu	0 to 150	0.16	0.20	0.23	0.27	0.35	0.41
Ohms	0 to 196.99	0.005	0.042	0.059	All Units In Ohms		
	0 to 999.99	0.05	0.22	0.31			

NOTE: Shaded area is 0.01° resolution; unshaded area is 0.1° resolution

* *Total instrument accuracy. Does not include RTD probe errors. Valid for 4-wire RTDs only. Microcomputer Type 1 no longer available.*

2189A Thermometry System Specifications

Includes Platinum RTD Probe Y2039.

Maximum System Error (±°C)

Temperature °C	At Calibration	90 Days 18°C-28°C Ambient	1 Year 18°C-28°C Ambient
Low Temperature Range. . .			
-183	(1)	(1)	(1)
-50	0.04	0.08	0.11
0	0.03	0.07	0.09
50	0.05	0.10	0.13
100	0.07	0.12	0.16
150	0.08	0.15	0.20
200	0.09	0.17	0.23
High Temperature Range. . . Periodic probe exposure*			
204	0.14	0.25	0.27
300	0.18	0.32	0.33
400	0.21	0,39	0.40
480	0.29	0.48	0.50

(1) The system operates down to -183°C but the probe calibration is not verified below -50°C. It is estimated that the accuracy below -50°C is the same as the accuracy at an equal temperature in the positive range. Low temperature calibrations are available as a special.

**Accuracy above 200°C is based on the user performing an Ice Point adjustment in accordance with the following schedule:*

Probe Exposure Temperature Range	*Total Exposure Time Before Adjustment*
200°C to 350°C	*500 hours*
350°C to 480°C	*250 hours*

Exposure of the Y2039 at high temperatures for long periods of time may cause the probe to change its characteristics and require the accuracy specifications to be degraded. For example, there is a 20% probability that exposure at 480°C for 500 hours will require degrading. It is easy for the user to determine if degrading is necessary by measuring the Ice Point resistance of the probe. The 2189A Instruction Manual explains this degrading procedure.

Option Specifications

Output Option (-002)

Analog Output

Type: Linearized and isolated
Voltage: 1.0 mV/°C or °F from -425 mV to 4.5V, 5 mA max
Temperature Coefficient: 200 ppm/°C from 25°C
Noise: ≤100 μV at 100 Hz bandwidth
Accuracy: ±0.1% of reading ±1 mV
Drift: 200 μV/°C from 25°C
Overload or Open T/C Circuit: Zero volts via banana jacks

Digital Output

Types: Four, E.I.A. Standard RS-232-C, TTY current loop, parallel ASCII, and Fluke PTI
Connector: 36-pin AMP "Champ"
Serial Baud Rates: 110, 150, 300, 600, 1200, 2400, 4800, or 9600, switch-selectable
RS-232-C Signals: Transmitted Data, Request to Send, Clear to Send, Data Set Ready, Signal Common
Parallel ASCII Signals: Data: 8 lines; Instrument Address: 4 lines; Address Valid; Data Valid; Acknowledge; Ground; +5V
TTY Current Loop Signals: Source and controlled sink, 20 mA
Out-of-Limit Signals: Exclamation point transmitted with Option -006 only; not with Y2002

IEEE-488 Option (-004)

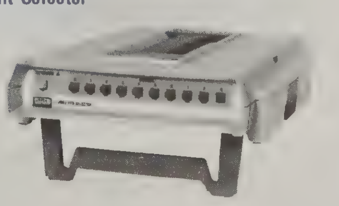
Repertoire: SH1, AH1, T6, L0, SR1, RL0, PP0, DC0, DT0, C0, E2
Service Request Usable: Yes
Power: Operates only when powered by AC line

Limits Option (-006)

Limits Function: Lights LED and activates Form A (SPST) reed relay when thumbwheel setpoint is exceeded. Reed relay rated 10 VA, 184V dc or 130V ac rms max, 0.5A max, resistive. Selectable either low (≤) or high (>).
Min/Max Function: Continuously stores Min and Max temperature
Delta Function: Displays difference between thumbwheel setpoint and actual temperature
Thumbwheels: 6, for function, sign, and setpoint (±9999). Setpoint resolution is 1°

Accessory Specifications

Y2000 RTD Multipoint Selector

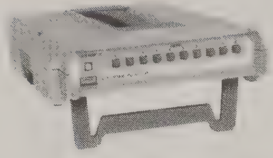


Y2000

Channels: Ten per Y2001, up to ten Y2001s per 2190A. Channel number sent to printer or computer when Output Option -002 or -004 are used
RTD Types: Same as 2180A. Two types selectable per Y2000
Power: Supplied by 2180A
Interfacing: Attached 46-cm cable plugs into rear of 2180A or Y2002. Receptacle accepts cable chained from other Y2000s
Size and Weight: Style A PTI case, 1.4 kg (3.09 lb)

2180A/2189A/2190A TemPak Series

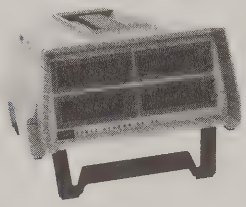
Y2001 Thermocouple Multipoint Selector



Y2001

Channels: Ten per Y2000, up to ten Y2000s per 2180A. Channel number sent to printer or computer when Output Option -002 or -004 are used
Thermocouple Types: Same as 2190A. Two types per Y2001
Maximum Voltage Between Channels: 125V ac rms
Power: Supplied by 2190A
Interfacing: Attached 46-cm cable plugs into rear of 2190A or Y2002. Receptacle accepts cable chained from other Y2001s
Size and Weight: Style A PTI case, 1.6 kg (3.53 lb)

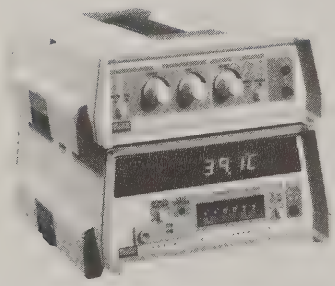
Y2002 Alarms Output



Y2002

Limit Selections: Four sets of thumbwheels. Each set selectable as a ±9999° high- or low-limit setpoint
Alarm Indication: LED and reed relay — one for each limit setpoint
Relay Rating: Form C (SPDT), 230VA, 184V dc or 130V ac rms max, 2A max resistive, selectable latching or non-latching
Power: Supplied by 2180A or 2190A
Interfacing: Attached 46-cm cable plugs into rear of thermometer. Receptacle accepts cable from Y2000 or Y2001
Size and Weight: Style C PTI case, 1.8 kg (3.97 lb)

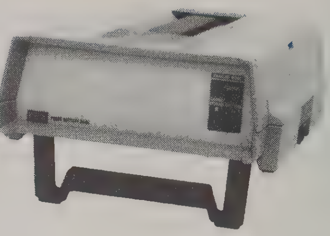
Y2003 Thermocouple Calibrator and Battery Pack



The 2190A/Y2003
Portable Calibration System

Thermocouple Types: Same as 2190A
Output Voltage: -10 mV to +90 mV, adjustable. Applied at input terminals of 2190A and thermocouple thermometer of less accuracy to be calibrated
Adjustments: Coarse, fine and offset
Battery Pack: Same specifications as Y2009
Interfacing: Attached 46-cm cable plugs into rear of 2190A
Size and Weight: Style B PTI case, 2.6 kg (5.74 lb)

Y2009 Rechargeable Battery Pack



Y2009

Output: 12V dc, 750 mA max
Battery: Ten ½-D-size cells in drip-proof case
Operating Time: 5 to 6 hours typical at 25°C on full charge when connected to 2180A, 2190A
Recharge Time: 16 hours typical at 25°C
Charger: Built-in on-off switch, low-battery automatic discharge cut-off
Output Connectors: Rear panel screw terminal block
Operating and Storage Temperature: 0°C to 40°C
Power: 100, 120, 220, or 240V ac ±10% selectable, 50 to 400 Hz; 10W, typical
Size and Weight: Style B PTI case, 2.5 kg (5.52 lb), typical

Y2022 Thermometer Calibration Divider (D in Picture)

Function: Either precision resistor or voltage divider (÷10 or ÷100)
Input Voltage: 0-10V dc
Output Impedance: 100Ω
Precision Resistor: 100Ω ±0.01Ω, temp coefficient 5 ppm

Y2024 3-Module Power Cord (E in Picture)

Connects three PTI-family instruments or accessories to single 120V ac power outlet

Y2026B RS-232-C Cable Adapter (C in Picture)

Function: Routes RS-232-C signals from 36-pin PTI connectors to 25-pin RS-232-C connectors
Connections: Two 36-pin PTI connectors (M and F), two 25-pin RS-232-C connectors (M and F). Y7203 cable supplied
RS-232-C Pin Selections: Slide switches. Select TD on pin 2 or 3; DTR, DSR and CTS, through or pulled up; Scanner busy, through or to CTS

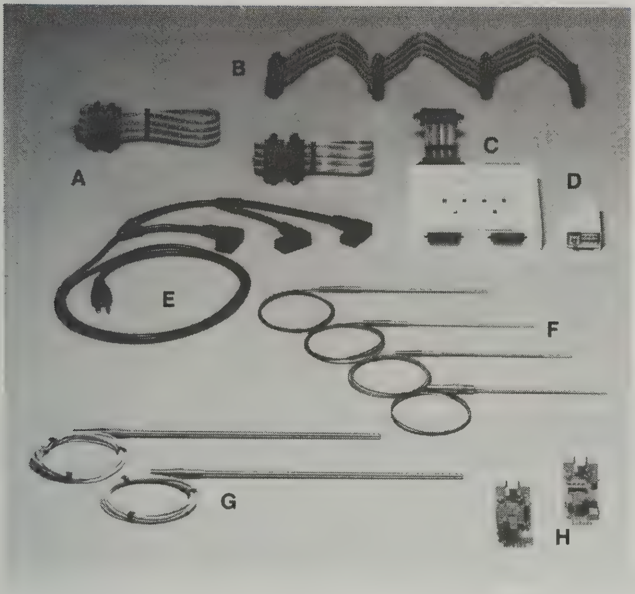
Y2030 Plug-in Module (H in Picture)

Extra plug-in units for 2190A thermocouples. Leave attached to input wire-pair for easy interchange of thermocouple inputs.

Y2031 Plug-in Module (H in Picture)

Extra plug-in unit for 2180A RTDs. Leave attached to input wires for easy interchange of RTD inputs.

A Family of Accessories



Small accessories shown are: **(A)** *Y7203 and Y7204 PTI Polling Cables,* **(B)** *Y2036 3-Module PTI Polling Cable,* **(C)** *Y2026 Cable/Adapter,* **(D)** *Y2022 Calibration Divider,* **(E)** *Y2024 3-Module Power Cord,* **(F)** *P20-Series Thermocouple Probes,* **(G)** *Y2037 and Y2039 RTD Probes,* **(H)** *Y2030 and Y2031 Plug-In Modules.*

Y2036 PTI Polling Cable

Connects up to three PTI-family measurement instruments to 2020A or 2030A Printer

Y2037 Platinum RTD Probe

Resistance: 100Ω ±0.1Ω at 0°C
Temperature Range: -80°C to +480°C
Curve Conformity: ±0.1% of temperature using IPTS 68 with ALPHA = 0.0038994 and DELTA = 1.494
Stability: Periodic usage (20% of time) ±0.03°C if used from 0°C to 200°C and ±0.22°C if used from -80°C to +480°C
Hysteresis: Less than ±0.08°C when using 0°C and 200°C as end points
Immersion Effects: ±0.005°C when going from 4 inches to 10 inches in an ice bath
Transition End Temperature: 150°C maximum
Physical: 316 SS Sheath, 0.25 in diameter x 12 in L; four 6 ft leads #22 AWG stripped and tinned
Handling: Contains strain-free platinum coil. Must be handled with care

Y2039 Platinum RTD Probe

Probe Resistance: 100Ω ±0.1Ω at 0°C
Temperature Range: -183°C to +480°C
Performance Standard: R100°/R0° = 1.3922, nominal. Conforms to IPTS 68 within 0.03% of temperature from -50°C to 420°C using ALPHA = 0.0039221 and DELTA = 1.493
Resistance Stability: 12 mΩ/year when exposed at 200°C or 20 mΩ in 250 hours when exposed at 480°C measured with probe at 0°C. 4 mΩ = 0.01°C + 0.004% of temperature
Hysteresis: Less than 0.01°C at 200°C when using 0°C and 420°C as end points
Immersion Effects: The readings shall not vary more than 0.005°C when probe is varied from 4 to 10 inches in an ice bath
Transition End Temperature: 150°C maximum
Time Constant: 8 seconds maximum when tested in flowing water at 3 feet per second
Sheath Material: INCONEL
Size: Diameter 0.64 cm (0.25 in), length 30.5 cm (12 in)
Leads: 4 wires, 6 ft, #22 AWG, ends stripped and tinned
Calibration: Each probe is calibrated at 0°C, 200°C and 420°C. The IPTS 68 constants R0, ALPHA, DELTA and A4 are provided
Handling: Contains strain-free platinum coil. Must be handled with care

PTI Case Dimensions

Style	Height	Width	Depth
A	5.7 cm (2.25 in)	20.5 cm (8.05 in)	32.6 cm (12.85 in)
B	8.2 cm (3.23 in)		
C	10.5 cm (4.13 in)		
D	12.8 cm (5.03 in)		

General Specifications for 2180A/2189A/2190A

Display: °F or °C, switch-selectable; 7 segment 1.1 cm LEDs
Measurement Method: Dual-slope integration, 100 ms integration time, 3.33 readings/second
Linearization Technique: Segmented 4th order curve fit
Temperature Coefficient: ±15 ppm/°C from 25°C
Stability: 175 ppm/90 days, 200 ppm/year
Common Mode Voltage: 350V dc, 250V rms ac, max
Common Mode Noise Rejection: ≥160 dB at 50, 60 and 400 Hz ±0.1% 100Ω unbalance
Normal Mode Noise Rejection: ≥90 dB at 50, 60 and 400 Hz ±0.1%
Drift: None, automatic zero correction
Input Impedance: 1000 MΩ at dc
Accessory Connector: 25-pin rear panel receptacle interfaces thermometer to Y2000, Y2001, Y2002, Y2003, and 2300A
Shock and Vibration : Meets MIL-T-28800C, class 3 specifications
Ambient Temperature: 0°C to 50°C operating, -40°C to 75°C non-operating
Relative Humidity: ≤80% from 0°C to 50°C non-condensing
Power: 12V dc or 100, 120, 220, 240V ac ±10%, selectable, 50 to 400 Hz; 8W typical
Size: Style C PTI case
Weight: 2.1 kg (4.63 lb)
Included: Instruction manual, power cord. Probes are not included

Models

January 1986 prices

RTD Thermometers

2180A Type 2 Linearizations*	$1095
2189A System	1795

**Contact factory for 3-wire 10Ω copper applications*

Thermocouple Thermometer

2190A Type 1 — J, K, T, R, C	1045
2190A Type 2 — J, K, E, R, S	1045
2190A Type 3 — J*(DIN)*, K, T*(DIN)*, B, R	1045

Options***

21X0A-002* Output	395
21X0A-004 IEEE-488 Output	395
21X0A-006 Limits	255
2XXXA-522** Personality Card for 1120A	390

Note: Above options are field-installable.
** Required for compatibility with 2020A-004 or 2030A Printer or 1120A Translator. However, the option is not required when the thermometer is used with a 2300A Scanner, unless analog output is also needed. Mutually exclusive with 21X0A-004.*
*** Required with 1120A Translator. Y7203 or Y7204 Cable also required.*
**** All options are customer installable*

IEEE-488

DIGITAL THERMOMETERS

2180A/2189A/2190A TemPak Series

Accessories (Also see page 230)

Y2000	Multipoint Selector for RTDs	610
Y2001	Multipoint Selector for Thermocouples	610
Y2002	Alarms Output Module	720
Y2003	Thermocouple Calibrator/Battery Pack	685
Y2009	Battery Pack, Rechargeable	430
Y2022	Thermometer Calibration Divider	125
Y2026B	RS-232-C Cable Adapter	170
Y2030	Thermocouple Input Module	90
Y2031	RTD Input Module	90
Y2023	Size C PTI Case w/drawer	125
Y2024	3-Module Power Cord	20
Y2036	PTI Polling Cable	80
Y2037	RTD Probe 100Ω 390 PT	260
Y2039	RTD Probe 100Ω 392 PT	700
Y7203	2-ft 36-pin PTI Cable	50
Y7204	5-ft 36-pin PTI Cable	65

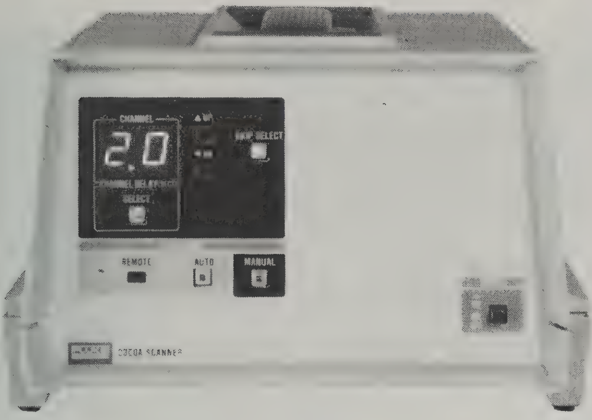
Also see page 171, 2030A Printer/Plotter; page 165, 2300A Scanner and page 150, IEEE-488 Translator.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

TEMPERATURE SCANNER

2300A TemPak Series



2300A

2300A Temperature Scanner

- Can be used with either thermocouples or RTDs
- Capable of scanning 20 points, and expandable to 100 points with the 2301A Extender Chassis
- Scanning can be either manually or automatically with a set interval time
- Unused channels can be skipped either through a switch setting or programmed from the front panel
- Two interface options. One provides remote programming capabilities
- LED display specifies the channel being monitored
- Two different types of thermocouples or RTDs can be used per input card
- Designed to be integrated with a wide variety of instruments and accessories through an integral latching system
- Capable of running off of 12V dc or ac line power

The 2300A Temperature Scanner is designed to be used with either a Fluke 2180A or 2190A Digital Thermometer to sequentially scan and read the temperature of up to 20 RTDs or thermocouples. For even more capacity, a 2301A Scanner Extender can be added to scan an additional 30 sensors. Two 2301As may be stacked and latched together to scan up to 80 channels and a third may be added to scan up to 100.

Scanning may be done one channel at a time manually, with keystrokes at the front panel, or automatically. Readings also may be printed at pre-selected intervals using either a Fluke 2030A Printer or a 2020A Printer with the relevant options. All of these instruments are packaged in Fluke stack-and-latch cases that quickly and easily fit together to become an integrated, multichannel, temperature scanning and logging system. Using a 12V battery, a system may be operated in the field, away from any ac power source.

Scanner Card Options (-002 & -003)

Both the -002 Thermocouple Scanner Card Option and the -003 RTD Scanner Card Option provide for 10 sensor inputs. The inputs are divided into two blocks of five, so two different thermocouple types (or two different RTD types) may be used with each card. A switch allows you to automatically skip any unused channels, or you may skip them from the front panel of the Scanner.

Up to two cards (20 channels) may be housed in a 2300A Scanner, and up to three cards (30 channels) in a 2301A Scanner Extender. At least one scanner card is required for the 2300A to operate. Thermocouples and RTDs may not both be scanned at the same time by one 2300A.

Interface Card Options (-005 & -006)

Two interface options are available. One or the other is required and only one may be installed at a time. Either option will interface to either a 2180A or 2190A, and both provide RS-232-C output for communication to external printers or computers. Only Option -006 allows remote control of the Scanner, however, via either a bi-directional RS-232-C link or via the IEEE-488 bus (with the 1120A Translator). No interface option is required for a 2301A Scanner Extender.

The Y2026B RS-232-C Cable Adapter is available to connect the 36-pin connector on the back of the Scanner to a cable with a standard 25-pin connector. Or you can wire your own cable to the connector provided.

Specifications

Channel Capacity: 10 or 20 channels in a 2300A; 10, 20, or 30 channels in each 2301A Extender Chassis; 100 channels per system, maximum. Each system to scan only RTDs (2180A) or only thermocouples (2190A)
Front Panel Programming: Automatic or Manual Scanning, Channel Skips, Channel Delay Time, Fast Forward, Fast Reverse
Display: Two digits, 00 through 99; either channel number or channel delay time
Channel Delay Time: Time interval between scanner relay contact closure and scanner trigger signal that initiates measurement instrument reading. Programmable from 0.0 to 8.0 seconds, 2 seconds or greater required for rated accuracy
Printer Control of Scan Interval: Either the 2020A Printer (with Option -004 and -006) or the 2030A Printer can be programmed to control the time between each scan cycle when connected to the 2300A
Scan Speed: Dependent on measurement instrument and application
Required Options: One Interface Option (-005 or -006) and at least one Scanner Card Option (-002 or -003). Also, one to three scanner card options per 2301A Extender Chassis
IEEE-488 System: Requires 1120A Translator with Option 2XXXA-522 installed and Y7203 PTI cable
RS-232-C Compatibility: Y2026B Cable/Adapter recommended

Option Specifications

Thermocouple Scanner Card Option (-002)

Input Channels: 10
Input Connections: Two wires per channel on screw terminal isothermal block
Thermal Offset Error: 1 microvolt, max
Channel Switches: 2-pole reed relays
Max Input Voltage: 170V dc or peak ac
Max Common Mode Voltage: 350V dc or peak ac between any two channels or between the chassis and a channel
Thermocouple Types: See 2190A Thermometer Specifications
Switch-selectable Types: Two; five channels per thermocouple type
Reference Junction Compensation: Temperature-sense transistor on scan card isothermal block is used to send isothermal block temperature to 2190A for automatic ice point compensation

RTD Scanner Card Option (-003)

Input Channels: 10
Input Connections: 4-wire screw terminal
Thermal Offset Error: 10 microvolts max
Channel Switches: 3-pole reed relays
Max Input Voltage: 30V dc or peak ac
RTD Types: See 2180A Specifications
RTD Types Selectable: Two; five channels per RTD type

Interface Option (-005)

Interface Option -005 includes an attached accessory cable with a 25-pin male connector that plugs into the back of a 2180A or 2190A Digital Thermometer. The Option also provides a rear panel 36-pin connector for outputs to printers and computers

TEMPERATURE SCANNER

2300A TemPak Series

36-Pin Connector

The Portable Test Instrument (PTI) connector is used to transfer information from a 2300A Scanner and 2180A or 2190A Thermometer to a printer, RS-232-C device, or IEEE-488 bus via the Fluke 1120A Translator. The output information is: Channel number, temperature value, temperature scale (°C or °F), open circuit symbol, overrange symbol, limit-exceeded symbol (if 2180A or 2190A has Option -006), carriage return (CR), and line feed (LF). A Y7203 Accessory Cable is required for connecting a printer or 1120A Translator. A Y2026B Cable/Adapter is strongly recommended for transmitting RS-232-C signals

RS-232-C Signals: Transmitted Data, Request To Send, Clear To Send, Data Set Ready, Data Terminal Ready, Ground. Source and controlled sink of 20 mA for TTY current loop operation. Baud rates are 110, 150, 300, 600, 1200, 2400, 4800, or 9600, switch-selectable

IEEE-488 Signals: All IEEE Std 488-1978 signals when used with 1120A Translator with Option 2XXXA-522 installed. Interface functions SH1, AH1, T6, L4, SR1 can be implemented

Interface & Remote Control Option (-006)

Option -006 provides all the features of Option -005 plus the capability to be remotely programmed via the 1120A IEEE-488 Translator or RS-232-C terminal

I/O Connections: Same as Option -005 except 36-pin connector also used for remote control inputs

Signals: Same as Option -005 plus Received Data, Received Line Signal Detector, and Scanner Busy (for RS-232-C). TTY current loop is available as an output but cannot be used to send programming commands

Remote Programming: The 2300A accepts commands for programming channel delay time, channel skips, monitor channel, first and last channel single scans, and first and last channel continuous scanning. Programming is activated by sending command character codes on data lines of IEEE bus via the 1120A Translator or on the Received Data line via an RS-232-C device

Command Characters & Meanings

R	Place Scanner in Remote Control
L	Place Scanner in Local Control
D mm	Set channel delay time to m.m seconds
S mm-nn	Skip channels mm to nn
U mm-nn	Unskip channels mm to nn
M mm	Monitor channel mm
A mm-nn	Continuously scan from channel mm to nn
X mm-nn	Make a single scan from channel mm to nn
RP	Print Scan Mode
MP	Print current channel
AP	Print first and last channels
XP	Print first and last channels
DP	Print channel delay

General Specifications

Ambient Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating

Relative Humidity: ≤75% to 50°C, operating; ≤95% to 70°C, non-operating

Safety Standards: IEC 348 Protection Class I, solely as it relates to insulation or grounding properties

Power

2300A: 100 to 130V ac or 200 to 260V ac, switch-selectable, 50 to 60 Hz, or 12V dc. 8 Watts

2301A: Supplied by the 2300A Scanner mainframe

Size: Style D PTI case, 13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in x 8.05 in x 12.85 in) both 2300A and 2301A

Weight

2300A: Approximately 3.6 kg (8 lb) depending on the options

2301A: Approximately 2.7 kg (6 lb) depending on the scanner cards installed

Included

2300A: Instruction manual, power cord, attached cable for 2180A or 2190A

2301A: Instruction manual, attached cable for 2300A or another 2301A

Models

January 1986 prices

2300A Scanner	$675
2301A Extender Chassis	425

Interfacing a 2300A Scanner/Thermometer combination to the IEEE Bus requires a Y7203 or Y7204 Cable, the 1120A Translator and the 2XXXA-522 Personality Card. The 21X0A-002 or 21X0A-004 thermometer options are not required.

Options

2300A-002	Thermocouple Scanner Card	435
2300A-003	RTD Scanner Card	435
2300A-005*	Interface and Output	325
2300A-006*	Interface, Output and Remote Control	1097

** Includes attached ribbon cable for 2180A or 2190A. For factory or Service Center installation only.*

Accessories (Also see page 230)

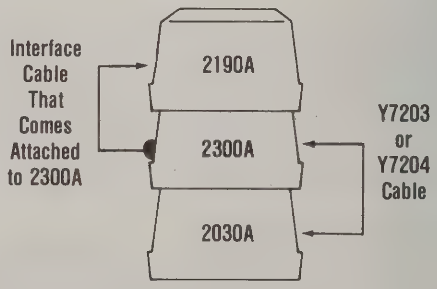
1120A IEEE-488 Translator	550
2XXXA-522* Personality Card for 1120A	390
Y7203 36-Pin PTI Cable, 2 ft	50
Y7204 36-Pin PTI Cable, 5 ft	65
Y2026B** RS-232-C Cable/Adapter	170

** Required with 1120A Translator for IEEE-488 compatibility. Y7203 or Y7204 Cable also required.*

*** Includes cable for connection to 2300A. Has both male and female 25-pin RS-232-C connectors and switches for handshake flexibility.*

After-Warranty Service (See page 227)

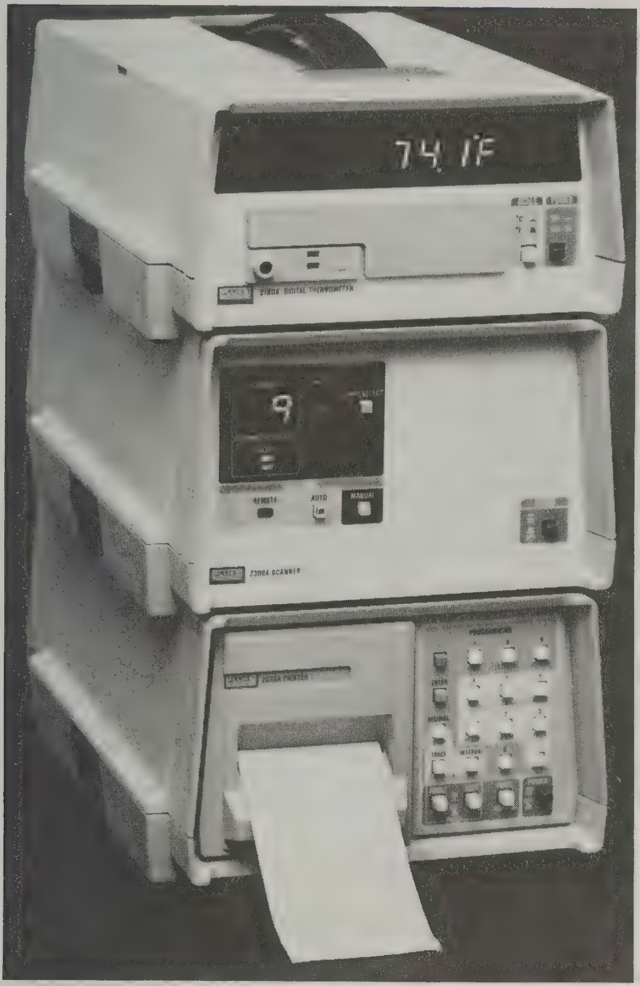
A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



Typical Cable Connections

TEMPERATURE LOGGING SYSTEMS

2382A/2383A/2392A/2393A Temperature Logging Systems



2393A Temperature Logging System

2382A/2383A/2392A/2393A

- Completely configured and tested temperature logging systems
- Capable of running off of 12V dc or ac line power
- Capable of scanning 20 points, and expandable to 100 points with the 2301A Extender Chassis
- Scan either manually or automatically with a set interval time
- Your choice of either the 2020A or the 2030A Printer and either RTD or thermocouple capability
- Six different RTD types are switch selectable. Four platinum, one nickel, one copper, (2382A and 2383A only)
- Ten different thermocouple linearizations are supported including two DIN standards, (2392A and 2393A only)

Four portable, factory-integrated and tested temperature logging systems are available. They offer a choice of thermocouple or RTD measurements and a choice of two printers — the Fluke 2020A or 2030A. Temperature information from up to 10 sources may be logged using any of the four systems, or up to 20 by ordering one additional scanner option (-003 for RTDs or -002 for thermocouples). And each system may be expanded to monitor up to 100 points. Although the component parts may be ordered separately and assembled by the user, choosing the right combination of instruments, options, cables, etc., for your application is simplified by purchasing one of the four systems. There is even a modest price advantage in purchasing a factory-tested system. Each offers the most accurate temperature logging capability that Fluke manufactures.

The following chart shows the component parts of the four systems.

System Components

Items Included	RTDs		Thermocouples		See Page
	2382A	2383A	2392A	2393A	
2180A Thermometer	1	1	—	—	158
2190A Thermometer	—	—	1	1	158
2300A Scanner	1	1	1	1	165
Option -005	1	1	1	1	165
Option -003*	1	1	—	—	165
Option -002*	—	—	1	1	165
2030A Printer	—	1	—	1	171
2020A Printer	1	—	1	—	168
Option -004	1	—	1	—	169
Y7203 Cable	1	1	1	1	163
Y2024 Power Cord	1	1	1	1	163

** Ten channels per option. One additional option may be installed in the 2300A. Up to 3 additional options may be plugged into each additional 2301 Scanner Extender. Maximum number of channels is 100.*

Specifications

Please refer to the pages listed above for the specifications and performance characteristics of the instruments and options comprising each system

Models

January 1986 prices

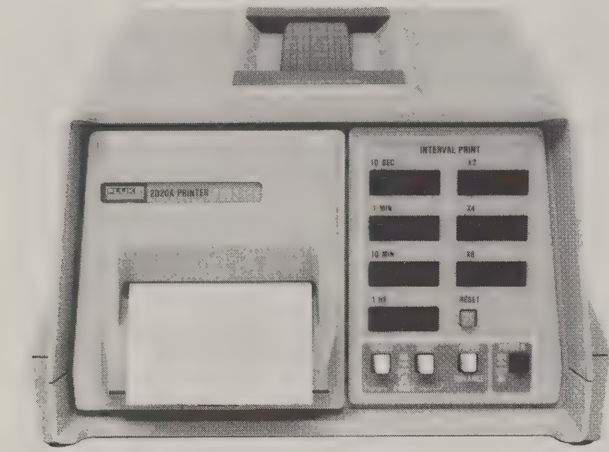
Model	Description	Price
2382A	RTD System with 2020A Printer	$3795
2383A	RTD System with 2030A Printer	3895
2392A	T/C System with 2020A Printer	3755
2393A	T/C System with 2030A Printer	3895

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

UNIVERSAL & COMPUTING PRINTERS

2020A TemPak Series



2020A With Option -006

2020A Universal Printer

- 20-column thermal printer for recording data from a variety of instruments
- Five different interface options are available: Parallel ASCII, RS-232-C, IEEE-488, PTI Polling or Parallel BCD
- Designed to be integrated with a wide variety of Fluke instruments and accessories through an integral latching system
- Time interval print capability with the -006 option
- Capable of running off of 12V dc or ac line power
- Single or continuous print cycles can be triggered either from the front panel or using the remote trigger connector on the rear of the instrument
- Graphic plotting available when using the -001 or the -003 interface

Both the 2020A and 2030A Printers have 20-column thermal print heads for recording measurement data from a variety of Fluke instruments. Especially recommended are those instruments packaged in Fluke's Portable Test Instrument (PTI) cases. They will stack and latch to a 2020A or 2030A Printer and to one another. Connecting cables attach to the rear panels.

Because the 2300A Scanner is designed to let you measure the temperature of numerous points with just one Fluke 2180A or 2190A Thermometer, the 2020A and 2030A Printers are particularly recommended for temperature scanning and logging. Thermometer, scanner, and printer are stacked and latched together and used as an integrated temperature measuring system. The following chart gives a quick comparison of the two printers.

Comparison of 2020A and 2030A Printers

Features	2020A	2030A
Prints		
Measured data	Yes	Yes
Computed data	No	Yes
Data source identification	Yes	Yes
Real time	No	Yes
Elapsed time	Opt -004	Yes
Time interval	Opt -006	Yes
Engineering units	No	Yes
Header	No	Yes
Strip chart graph	*	Yes
Print Cycle		
Front panel trigger	Yes	Yes
Remote trigger	Yes	Yes
Front panel continuous	Yes	Yes
Remote continuous	Yes	Yes
Pre-selected intervals	Opt -006	Yes
When limit crossed	No	Yes
Intervals and crossings	No	Yes
Computed Data		
mx+b scaling	No	Yes
± difference (delta)	No	Yes
±% (% delta)	No	Yes
Interfaces		
Fluke PTI	Opt -004	Yes
RS-232-C	Opt -002	No
IEEE-488	Opt -003	No
Parallel ASCII	Opt -001	No
Parallel BCD	Opt -005	No

* *Using Option -001 or -003 and 1722A Instrument Controller or similar computer.*

2020A Universal Printer

The Fluke 2020A is a 20-column thermal printer — the first printer with five interchangeable data interface options. Whether you need IEEE-488, RS-232-C, BCD, parallel ASCII, or Fluke's own Portable Test Instrument (PTI) polling interface, the 2020A has the option to match. The 2020A operates from either the ac power line or a nominal 12-volt dc source.

Graphic Printing

The 2020A with a parallel ASCII or IEEE-488 interface is capable of printing a dotted graph of incoming data. The data source must send the correct 8-bit binary code for trace-on, 0 through 99 for the dot location, line feed, and finally trace-off. Use this feature to plot trends and trace profiles in addition to normal print out.

PTI Polling

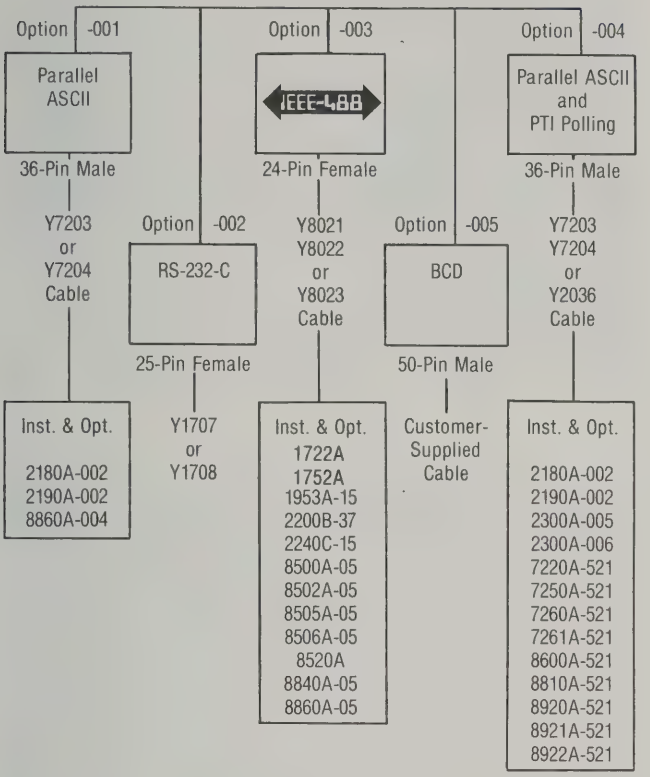
The 2020A's PTI polling interface contains a microcomputer with addressing intelligence designed to generate the assigned addresses of several instruments in the PTI family. Select a print mode and the 2020A automatically begins polling by sequentially sending addresses one through nine until a measurement instrument recognizes its address. The 2020A then prints both the address and the instrument's current reading. A typical polling system might include the 2020A with a 2190A Thermometer and a 8920A Voltmeter.

Time Interval Printing

Fluke offers the 2020A with time interval printing (Option -006). It allows printing at preselected time intervals from ten seconds up to eight hours. When you use the time interval print option and a PTI polling interface, the 2020A will automatically label the printer tape with elapsed time each time it prints a set of readings.

2020A TemPak Series

Your choice of five field-installable interface circuit cards.



Option Specifications

Parallel ASCII Interface (-001)

Input Connector: 36-pin AMP CHAMP, male
Signals: Data, 8 lines; Data Valid; Data Acknowledge
Signal Levels: Data, positive True, ⩾ + 3.5V. Data Valid, Data Acknowledge lines — negative True, ⩽ + 1.5V
Character Set: 64 upper case ASCII plus °, f, k, m, n, p, Ω, s, μ, z
Graphic Printing: Dotted trace activated by receipt of the following binary-coded decimal numbers on incoming data lines: in-trace — 16, dot location — 0 through 99, line feed — 254, out-trace — 255.

RS-232-C Interface (-002)

Input Connector: Standard 25-pin, female
Signals: Transmitted Data, Clear to Send, Data Set Ready, Signal Ground, Received Line Signal Detector
Baud Rates: Switch-selectable for 110, 150, 300, 600, or 1200
Character Set: 64 upper case ASCII plus °, f, k, m, n, p, Ω, s, μ, z
Buffer Storage: 32 characters

IEEE-488 Interface (-003)

Input Connector: Standard 24-pin, female
Signals: Per IEEE Std 488-1978
Modes: Listen only or Addressable Listen, Switch-selectable
Repertoire: AH1, L1
Character Set: 64 upper case ASCII plus °, f, k, m, n, p, Ω, μ, z
Graphic Printing: Dotted trace activated by receipt of the following binary-coded decimal numbers on incoming data lines: in-trace — 16, dot location — 0 through 99, line feed — 254, out-trace — 255.
Buffer Storage: 1 line of data

PTI Polling Interface (-004)

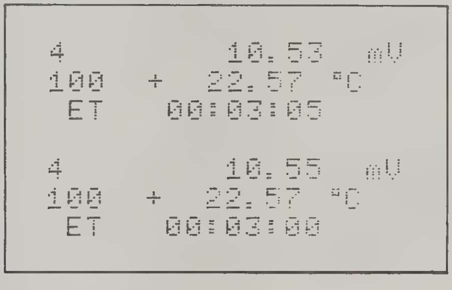
Multi-Instrument Scanning: Up to nine Fluke measurement instruments with each having an internal preset address as follows: Adr 1 — 2180A, 2190A, 2300A; Adr 2 — 7250A, 7260A, 7261A; Adr 3 — 7220A; Adr 4 — 8920A, 8921A, 8922A; Adr 5 — 8600A, 8810A; Adr 6,7,8,9 — 2180A, 2190A, 2300A
Input Connector: 36-pin AMP CHAMP, male
Signals: Data, 8 lines, Address, 4 lines; Address Valid; Data Valid; Data Acknowledge; Scan in Progress
Character Set: 64 upper case ASCII plus °, f, k, m, n, p, Ω, s, μ, z
Buffer Storage: 1 line of data

Parallel BCD Interface (-005)

Input Connector: 50-pin AMP CHAMP, male. Mating female connector included
Signals: Data, 44 lines; Busy; Trigger Out, 2 lines, positive or negative true
Signal Level: ⩾3.5V positive True, TTL, DTL, CMOS B series
Decimal Point: Either fixed location (switch-selectable) or remotely BCD programmed, determined by jumper position
Column Usage: Either 7 columns of data and 4 columns of annotation with switch-selectable decimal point or 7 columns of data and 3 columns of annotation with programmable decimal point position, jumper selectable
Buffer Storage: 1 line of data

Time Interval Print (-006)

Print Intervals: Choice of 10, 20, 40, or 80 seconds, 1, 2, 4, 8, 10, 20, 40, or 80 minutes, or 1, 2, 4, or 8 hours
Time Annotation: Elapsed time printed with each reading when Option -004 installed
Clock: Internal, crystal-controlled



```
4          10.53   mV
100    +   22.57  °C
 ET      00:03:05

4          10.55   mV
100    +   22.57  °C
 ET      00:03:00
```

Sample section of printed tape showing two readings 5 seconds apart. Reading from bottom to top: Elapsed time (ET) is 00 hours, 03 minutes, and 00 seconds. Address 1 Channel 00 is for the thermometer and address 4 is for the voltmeter.

Specifications

Type: Thermal, 20-column
Characters: 5 x 7 dot matrix
Print Rate: 3 lines per second maximum
Spacing: 6 lines per inch (2.4 per cm)
Paper: 2.5 in (6.3 cm) wide, 240-ft roll (74 m)
Advance: Stepping motor, belt drive
Remote Operation: Rear input, by external contact closure, TTL/DTL compatible
Standards: IEC 348, Protection Class 1
Temperature: 0°C to 50°C, operating; −20°C to +70°C, non-operating
Relative Humidity: ⩽95% to 25°C; ⩽75% to 40°C; ⩽45% to 50°C
Power: 11 to 15V dc, 90 to 132V ac, or 180 to 250V ac, switch-selectable, 47 to 440 Hz, 40W maximum
Size: Style D PTI Case — 13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in x 8.05 in x 12.85 in)
Weight: Approximately 9 lb with paper
Included: Instruction manual, power cord, one roll of paper

UNIVERSAL & COMPUTING PRINTERS

2020A TemPak Series

Model

January 1986 prices

2020A	Printer	$875

Each printer requires one interface option and can only use one at a time.

Options

202XA-001*	Parallel ASCII Interface	285
202XA-002	RS-232-C Interface	345
202XA-003	Interface for IEEE-488	345
202XA-004*	PTI Polling Interface	345
202XA-005	Parallel BCD Interface	465
202XA-006	Time Interval Print	225

All options field-installable. Cables not included.
**Accepts Y7203 or Y7204.*

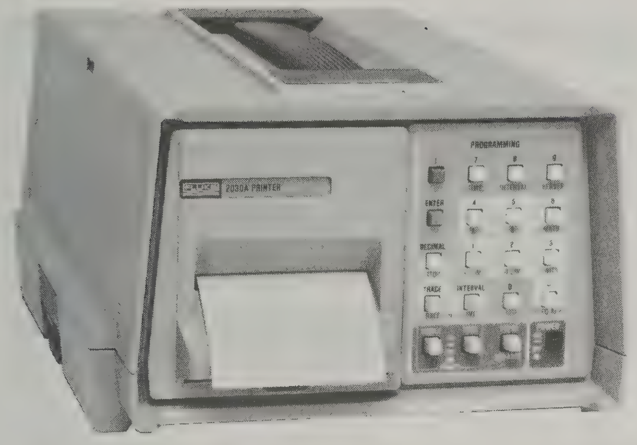
Accessories (Also see page 230)

Y2016	7" Rack Adapter, Single	90
Y2017	7" Rack Adapter, Double	90
Y2021	Panel Mounting Kit	90
Y2035	Thermal Paper, box of 10 rolls	65
Y2036*	PTI Polling Cable	80
Y7203	2-ft Cable, 36-Pin, PTI	50
Y7204	5-ft Cable, 36-Pin, PTI	65
Y8021	1m Cable for IEEE-488 bus	85
Y8022	2m Cable for IEEE-488 bus	95
Y8023	4m Cable for IEEE-488 bus	105

** Used when 2 or 3 PTI instruments are to be simultaneously connected to 2020A via Option -004. Use two cables for 4 or 5 instruments.*

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



2030A

2030A Computing Printer

- 20-column thermal printer for recording data from a variety of instruments
- Multi-instrument scanning (up to 9)
- Time annotation — real, elapsed, interval
- Engineering units annotation — up to 4 alphanumeric characters
- Seven print modes
- Runs off 12V dc or ac line power
- Trace mode allows plotting of data
- Designed to be integrated with a wide variety of instruments and accessories through an integral latching system
- Math mode allows you to program delta, %delta, and mx+b scaling
- Checks for both high and low alarms

The 2030A is a 20-column thermal printer with computing power. It combines standard printing performance with a multitude of other special features. It is capable of mathematically scaling data and automatically documenting the printed results. It can translate numeric data into a visual trace, and it can apply limits and activate alarms. The 2030A prints data in any one of seven modes—from a single reading to programmed printing at periodic intervals.

Seven Print Modes

Trace: Data graphically plotted between programmable limits
Interval Trace: Graphic trace of data plotted at programmed time intervals
Interval: Prints at programmed intervals
Interval Limit: Prints at programmed intervals and monitors for alarms when not printing
Single: Prints one reading when pushbutton is pushed
Continuous: Continuously prints up to three readings per second
Remote: Prints continuously when activated (via rear panel)

Time Interval Printing

Inside the 2030A is a precision crystal measuring time and allowing you to control when data is scanned and/or printed. A 99-hour clock is set from the front-panel keyboard; elapsed time starts automatically when the power is turned on. The 2030A automatically annotates the tape with the selected time whenever it prints data.

Multi-instrument Scanning

The 2030A's microcomputer contains addressing intelligence designed to generate the assigned addresses of PTI family instruments. Select a print mode and the 2030A automatically begins scanning by sequentially sending addresses one through nine until a measurement instrument recognizes its address. The 2030A then prints both the address and the instrument's current reading, and polls the next instrument having a higher address. A typical printing system might include the 2030A with a 2190A Thermometer and an 8920A Voltmeter. One or more Y2036 PTI Polling Cables are needed for connecting more than one instrument in parallel to the 2030A.

Math Power

Simply enter two 6-digit constants from the front panel and the printer can calculate the difference (delta) or percent difference (% delta) between a preselected reference value and the input data. You can also program the 2030A to scale the incoming data. You could, for example, correlate voltage and pressure, converting a range of 4-20 mA into 0-100 PSI.

Graphic Printing

Select the range of data you want to analyze and the 2030A will plot a dotted graph over a 2 inch full scale band of the tape. Simply program the right and left limits of the graph area as if they were 0% and 100%. Whether the measurement range is "0 to 1000" or "500 to 510," the 2030A automatically expands or contracts the range to fit within the 2 inch scale, and dot by dot plots a graph of the data you're recording.

Alarms

To control and monitor processes, the 2030A gives you the ability to continuously compare the reading of a measuring instrument against two programmable limits with six-digit resolution. If the reading exceeds either the high or the low limit, the 2030A prints the reading, the time, and activates an alarm output.

When the 2030A is in its trace mode, the edges of the graph also act as alarm set points.

Engineering Units

The 2030A can be programmed to annotate data with the engineering units you choose. It overrides the basic measuring instrument's units with four alphanumeric symbols. Use this feature for math scaling and offset to put converted data in the proper units, or to indicate % when printing percent or difference (% delta).

Mode and Function Identification

Each print mode and special function has a distinct label. At the beginning of each print cycle, the 2030A automatically prints the appropriate labels so you know just what operations are to be performed. In the "interval limit" mode, for example, the 2030A prints Hi and Lo followed by the values assigned to each limit.

All labels include real time or elapsed time when in use, instrument address, and a 6-digit header (HD) to indicate the month, day, and year or other meaningful documentation. The diversity of symbols and special diagnostic messages add up to data that's easy to interpret today or weeks from now.

Specifications

Printer Type: Thermal, 20-column
Characters: 5 x 7 dot matrix
Character Set: 64 upper case ASCII plus °, f, k, m, n, p, Ω, s, μ, z
Print Rate: One line for each linefeed command, 3 lines/second max
Spacing: 6 lines per inch (approximately 2.4 lines per cm)
Paper: 2.5 inches wide, 240-foot roll.
Paper Advance: Stepping motor, belt drive

2030A TemPak Series

Buffer Storage: 1 line of data
Decimal Point: Automatically printed in correct location
Print Head Test: Test pattern printed in all columns if paper advance depressed within 1 second of power turn on
Print Modes: SINGLE, CONTINUOUS, INTERVAL, INTERVAL LIMIT, TRACE, INTERVAL TRACE, and REMOTE (operated by contact closure, TTL- or DTL-compatible)
Programmable Units: Up to four characters programmed from front panel. Code set is 64 upper case ASCII characters plus °, f, k, m, p, Ω, s, μ and z. Overrides incoming units
Programmable Parameters: Time, Interval, Header, A constant, B constant, Hi Lim, Lo Lim, Units, Spec Adr. All are programmed from front panel
Clock: Internal crystal. Will measure time intervals and either elapsed time or real-time. Resolution is one second; range is 99 hours, 59 minutes, and 59 seconds. Four modes: Elapsed time only, real-time only, elapsed time and time interval, or real-time and time interval. Real-time runs continuously and elapsed time is reset at the start of each print cycle.
Alarm: Two 6-digit setpoints, assignable, corresponding to six least significant digits of any one measurement instrument. Output is open collector, 28V max. Sinks 30 mA max.
Graphic Printing: Trace is programmed by proper selection of A and B constants. Operates on one instrument. Graph scale is 2-1/8 inches (100 dots) wide. Ten percent scale markers printed. Accuracy ±2% of graph scale.

2190A/2030A Graphics Capabilities

Math: Programmable to do scaling, delta, and % delta computations by proper selection of A and B constants. Operates on one instrument. Six-digit printout, maximum. Accuracy dependent on scale selected.
Compatible Instruments & Options: 2180A-002, 2190A-002, 2300A-005, 2300A-006, 7220A-521, 7250A-521, 7260A-521, 7261A-521, 8600A-521, 8810A-521, 8920A-521, 8921A-521, 8922A-521
PTI Polling: Prints sequential readings from up to nine Fluke measurement instruments with each having an internal preset address as follows: Adr 1 — 2180A, 2190A, 2300A; Adr 2 — 7250A, 7260A, 7261A; Adr 3 — 7220A; Adr 4 — 8920A, 8921A, 8922A; Adr 5 — 8600A, 8810A; Adr 6 — 2180A, 2190A, 2300A; Adr 7, 8, and 9 — Indirect Addresses. When a thermometer accessory is attached to the 2180A or 2190A via the thermometer accessory connector, the combination of thermometer and accessory acts as one instrument when polled.
Thermometer Interface: Plug compatible with 2180A/2190A with 21X0A-002 output option installed
Scanner Interface: Plug compatible with 2300A Scanner. The 2180A or 2190A Thermometer attached to the 2300A Scanner does not require a 21X0A-002 output option.
Interface: Through 36-pin AMP CHAMP, male connector. Signals: Data, 8 lines; Address, 4 lines; Address Valid; Data Valid; Data Acknowledge; Scan in Progress.
Standards: IEC 348 Protective, Class 1
Temperature: 0°C to +50°C, operating; −20°C to +70°C, non-operating
Relative Humidity: ≤95%, 0°C to 25°C; ≤75% to 40°C; ≤45% to 50°C
Power: 11 to 15V dc, 90 to 132V ac, or 180 to 250V ac, 47 to 440 Hz, 40VA maximum
Size: PTI style D case — 13.1 cm H x 20.5 cm W x 32.7 cm L (5.15 in x 8.05 in x 12.85 in)
Weight: approximately 9 lb with paper
Included: Manual, power cord, one roll of paper

Model

	January 1986 prices
2030A Printer	$1415

Interconnecting cables not included. Order Y7203 or Y7204

Accessories (Also see page 230)

Y2016 7" Rack Adapter, Single	90
Y2017 7" Rack Adapter, Double	90
Y2021 Panel Mounting Kit	90
Y2035 Thermal Paper, box of 10 rolls	65
Y2036* PTI Polling Cable	80
Y7203 2-ft Cable, 36-Pin, PTI	50
Y7204 5-ft Cable, 36-Pin, PTI	65

** Required when 2 or 3 measurement instruments are simultaneously connected to the 2030A. Use two cables for 4 or 5 instruments.*

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

Specifications

Use the Measurement and Control chart to determine which product does the necessary signal conditioning and outputs the appropriate type of control signal. Use the Features chart to guide you in considering your other important requirements, such as speed of measurement, operator interface, programming environment, or remote operation.

Measurement and Control

Measurement	**2285B**	**2280B**	**1752A**	**2400B***	**2452MCS**
Thermocouples	11 Types	11 Types	7 Types**	12 Types	12 Types
RTDs	All Types	All Types	All 100 ohm pt. 385**	All Types	All Types
Resistance	To 64K	To 64K	—	To 64K	To 64K
DC Voltage Ranges	64 mV-64V	64 mV-64V	100 mV-100V	100 mV-100V	100 mV-100V
Max DC Resolution	1 μV	1 μV	124 μV	1 μV	1 μV
AC Voltage Ranges	5V to 250V	5V to 250V	250V**	5V to 250V	5V to 250V
DC Current	0 to >64 mA	0 to >64 mA	0 to 65 mA	0 to >20 mA	0 to >20 mA
Strain Gage	Yes	Yes	Yes**	Yes	Yes
BCD	Yes	Yes	Yes	Yes	Yes
Binary	Yes	Yes	Yes	Yes	Yes
Status (Contacts)	Yes	Yes	Yes	Yes	Yes
Counter	To 1 kHz	To 400 kHz	To 900 kHz	To 900 kHz	To 900 kHz
Event Totalize	Yes	Yes	Yes	Yes	Yes
Sequence of Events	—	—	—	Yes	Yes
Control					
Status or Alarms	0-100	0-1500	0-160	0-1024	0-1024
Int Relays (Max)	1	1	—	0-1024	0-1024
User-Defined BCD	Yes	Yes	Yes	Yes	Yes
Analog Voltage	—	To ±10V	To ±10V	To ±10V	To ±10V
Analog Current	—	4-20 mA	4-20 mA	4-20 mA	4-20 mA
Analog Resistance	—	—	—	To 102K	To 102K
PID	—	Yes	Yes	Yes	Yes
Stepper Motor	—	—	—	Yes	Yes

**Also requires host computer such as Fluke 1722A or 1752A*
***Using external signal conditioning*

Features

Features	**2285B**	**2280B**	**1752A**	**2400B***	**2452MCS**
Accuracy (dc V)	±.005%	±.005%	±.02%	±.005%	±.005%
Speed (CH/S)	20	20*	1000*	25	25 (High Resolution) 1000 (Medium Resolution)
Programming Environment	Menu Prompted	Menu Prompted	BASIC FORTRAN Assembly C	Fluke Measurement & Control Language	BASIC FORTRAN Assembly ProGen C
Operator Interface	Membrane Keypad	Membrane Keypad	Touch-Sensitive Display	Via Host	Touch-Sensitive Display
Analog Input Channels	100	1500	128	1000	1128
RS-232/IEEE-488	OPT	OPT	STD	OPT	STD
12V DC Operation	Yes	Yes	No	No	No
Memory Expansion	None	None	2.0M + Bytes	None	2.0M + Bytes
Graphics	Plot	Plot	Dot Address	Via Host	Dot Address
Permanent Data Storage	Host	Cartridge Tape	-Disk -Bubble	-Eprom -Host	-Disk -Bubble
Built-in Printer	Yes	Yes	No	No	No
Battery Back-up	Program, Clock	Program, Clock	Clock	None	Clock

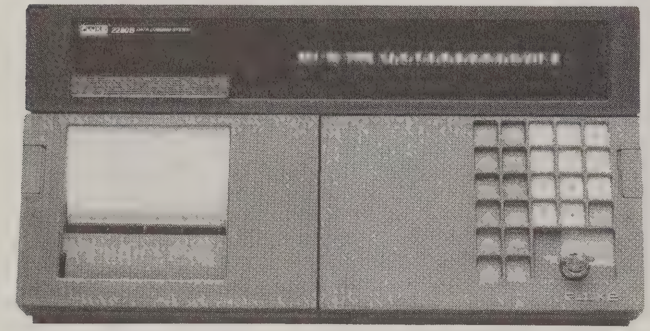
**Higher speeds possible with Multiple A/D Converters*

DATA LOGGERS

2280 SERIES

2280 SERIES Data Loggers

The 2280 SERIES, a family of advanced data loggers, combines high measurement accuracy, exceptional configurational flexibility, and computer-like power without requiring the user to write software. This family, composed of the 2285B Data Logger and the more powerful 2280B Data Logging System, offers solutions for demanding data acquisition and reporting problems.

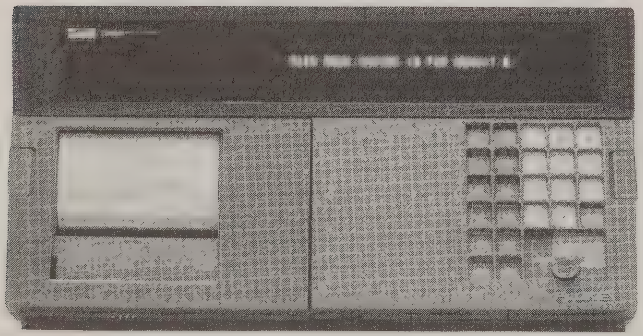


2280B

2280B Data Logging System

- Fluke's most powerful data logger
- Expandable to 1500 channels
- Precision measurements and control
- Flexible report generation
- 12V operation for mobile or field use
- Pseudo-channels give computer power without writing software

The 2280B Data Logging System, Fluke's most powerful data logger, is expandable from a simple 20 channel data logger to a distributed 1500 point data acquisition system. The 2280B Data Logging System accepts all 2280 SERIES options, offers the ultimate in data logging power and flexibility, and when equipped with an Analog Output Option (-170), the 2280B can even be programmed to implement PID control.



2285B

2285B Data Logger

- Economical solution for simpler applications
- Expandable to 100 channels
- Precision measurements
- Flexible report generation
- 12V operation for mobile or field use
- Pseudo-channels give computer power without writing software

For applications that do not require all the power or expansion capabilities of the 2280B Data Logging System, the 2285B Data Logger is a more economical solution. Expandable to 100 points, the 2285B accepts all 2280 SERIES options, except the Analog Output (-170), Counter/Totalizer (-167), Cartridge Tape (-214), and Advanced Math (-211) options.

Programming Ease

Both the 2285B and 2280B are programmed by responding to a series of English-prompted menus. Simple front panel responses to the displayed questions configure the 2280 SERIES to perform the required tasks. Instead of limiting the user to pre-defined functions, or requiring the development of libraries of application software, the 2280 SERIES employ pseudo-channels. An exclusive 2280 SERIES feature, pseudo-channels allow any mathematical relationship between channels, such as group averages; or between a channel and time, such as rate of change; to be described as a simple algebraic equation. With pseudo-channels, application problems that previously required the power of a computer, and an investment in software, are now possible in a stand-alone data logger.

Power to Get the Job Done

Accenting this computational power, the 2280 SERIES offer excellent documentation features. Each measurement channel, output channel or pseudo-channel can be uniquely identified with a 15 character label, clearly describing the point being logged. Adding further clarity, 6 character, user defined, engineering units for each point are a standard feature. Also standard is the ability to check every input, output or pseudo channel against alarm limits. Four high/low limits are available for each channel, and each limit can cause a user defined 40 character message describing the alarm condition to be recorded.

Report Generation

The 2280 SERIES allows its recording function to be easily tailored to the requirements of the job. Collected data, the results of calculations, or outputs can be viewed on the bright, 40 character vacuum fluorescent display, or logged on the wide format 40 character internal printer. Adding further recording flexibility are two communication ports which can be configured with optional RS-232-C or IEEE-488 interfaces. An optional DC100 magnetic tape drive is also available for the 2280B Data Logging System, allowing 500K bytes of data and/or programs to be saved on each tape.

For Demanding Environments

Applications that require more input or output points than can be housed in the mainframe are satisfied by using the 2281A Extender Chassis. These extender chassis are connected to the mainframe with a simple six twisted-pair cable, and communicate via a high speed, fault-tolerant, communication network. Since all communication is digital, signal integrity is assured in electrically noisy environments. Furthermore, any input or output options housed in an extender chassis have an operating range: -20°C to +70°C.

Portable Operation

Another standard feature is full operation from 12V dc power, making the 2280 SERIES a natural for mobile data acquisition. Connecting a 12V battery allows this dc operating mode to function as an uninterruptable power supply. The 2280 SERIES trickle charges the battery when on line power and bumplessly transfers to battery operation when line power fails, assuring measurement integrity for critical applications.

Specifications

Extender Chassis: As many 2281As as needed
Maximum Inputs, Outputs, & Pseudo Channels: ≤1500 points per system (2280B); ≤100 points per system (2285A)
Analog Inputs: ≤1500 channels per system (2280B), ≤100 channels per system (2285B)
Status, Binary, or BCD Inputs: ≤1500 lines per system (2280B), ≤100 lines per system (2285B)
Status Outputs: ≤1500 points per system (2280B); ≤100 points per system (2285B)
Alarm Outputs: ≤1500 points per system (2280B); ≤100 points per system (2285B)
Analog Outputs: ≤600 points per system (2280B only)
Computation Power: Besides built-in thermocouple and RTD linearizations, the 2280 SERIES will handle equations involving addition, subtraction, multiplication, division, and parentheses. Advanced Math Option (-211) (2280B only) adds square root, exponent, logarithm, trigonometric, standard deviation, interpolation tables, logic functions, equal-to, less-than, greater-than, etc.
Tasks: Up to 10 independent, prioritized scan groups
Scanning Speed: Depends on the number of A-to-D Converter Options (-161) per system and the system configuration. Example: Scanning dc voltage inputs for alarms at **full** accuracy:

- Up to **16** channels per second with **1** A/D Option
- Up to **30** channels per second with **2** A/D Options
- Up to **42** channels per second with **3** A/D Options
- Up to **65** channels per second with **5** A/D Options

Temperature: 0°C to 50°C operating (2280B/2285B); -20°C to 70°C operating (2281A)
System Communications: High speed digital data transferred between 2281As and a 2280B/2285B is via noise-immune twisted wire-pairs. May be linked in star and/or daisy-chain configurations
Distance To Extender Chassis: Any 2281A may be up to 1 km away from a 2280B/2285B
Failures: System component failures are reported as an alarm. All properly operating equipment continues with normal tasks

2280 SERIES Mainframe

CPU: Uses multiple 8-bit microprocessors with 128K bytes of ROM
I/O Capacity: Six slots for input and output options. One of the six slots must contain an A-to-D converter option when one or more analog input options is used. Each analog input option will scan 20 channels and each status or digital input or output option will handle 20 lines. If no A-to-D converter option is needed, each 2280B/2285B will handle up to 120 points of status inputs or outputs. Two additional plug-in slots are for any combination of one or two IEEE-488 or RS-232 options
Program Memory: 32K bytes (2280B); 20K bytes (2285B). Non-volatile. Battery back-up for at least 30 days, 90 days typical. Program may also be printed using internal printer or with optional interface to external devices
Internal Printer: Uses thermosensitive paper, 110 mm (4.4 in) wide. Up to 40 alphanumeric characters per line printed from 5x7 dot matrix, 2.6 lines per cm (6.7 lines per in). Each line printed below the previous line. Will plot one to four graphs from scanned or calculated data, instead of alphanumeric characters, using distinctive symbol for each graph in any of 276 discrete positions across width of paper. Automatic paper take-up reel prevents spilling and allows withdrawal of any printed portion for review
Power: 100, 120, 220, or 240V ac ±10%, 50 or 60 Hz. Or 10.5 to 15V dc. Ac power will trickle-charge 12-volt battery for uninterrupted power. Less than 120W fully loaded

2281A Extender Chassis

Capacity: Same plug-in options as 2280B/2285B
Power: Normally supplied by 2280B/2285B via 2281A-402 cable or equal. An optional built in power supply (2281A-431) may also be used and may be required for remote operation
Operating Temperature: -20°C to +70°C

DC100 Tape Drive Option (-214) (2280B only)

Used to store both scanned data and data logger programs. A single tape can contain multiple files of programs and/or data as the operator chooses. The tape is formatted with a directory which may be listed on the printer.

Four data compression formats are selectable for data recorded. Storage capacity is 500K bytes which is 11,300 to 41,600 channel readings dependent upon format selection.

Recorded date may be transferred to the internal printer or peripheral devices. The data transfer function permits data recorded at full speed to be transferred to a slower device such as the internal printer. The operator may transfer an entire file or part of a file based upon the time the data was recorded. For example, if a file contains data from a 24-hour test, the operator may only be interested in printing information gathered between 2:00 p.m. and 3:00 p.m. the operator enters these “start” and “stop” times and the 2280B searches for and transfers only those scans which were executed in the 2 to 3 p.m. time span.

Advanced Math Option (-211) (2280B only)

Functions: Absolute value, square root, exponential, sine, cosine, tangent, arc sine, arc cosine, arc tangent, common logarithm, natural logarithm, e^x, exponentiation, integer part, maximum value, minimum value, standard deviation, elapsed time
Logical Operators: AND, OR, NOT, EXCLUSIVE OR
Relational Operators: <, ≤, >, ≥, =, ≠
Interpolation Tables: ≤10, user-entered. Number of points per table is limited only by system memory

High Performance A/D Converter Option (-161)

One per 2280B/2285B and 2281A required for any analog measurement inputs.
Dynamic Range: 80,000 counts
Ranges: ±64 mV, ±512 mV, ±8V, and ±64V dc
Resolution: 1 μV on 64 mV range, 10 μV on 512 mV range, 100 μV on 8V range, 1 mV on 64V range
Common Mode Noise Rejection: ≥170 dB at 50 or 60 Hz ±0.1%; ≥160 dB at dc; 100 ohm unbalance
Normal Mode Noise Rejection: ≥60 dB at 50 or 60 Hz ±0.1%
Operating Temperature: -20°C to +70°C

2280B/2285B & 2281A Input Options

For These Inputs	Use Connector Option	With Scanner Option	Maximum Inputs per Scanner
Thermocouples	-175	-162 **	20
DC Voltage	-176 or -175	-162 **	20
DC Current	-171	-162 **	20
AC & DC Voltage	-160	-162 **	10 AC, 10 DC
RTDs or Ohms	-177	-163 **	20
RTDs, Ohms, Strain	-174*	-164 **	20
Status	-179	-168	20
BCD Digits	-179	-168	5
Binary	-179	-168	17 Bits & Sign
Frequency	-179	-167/AA	4
Frequency	none rqd.	-167	6 (2280B only)
Totalize Events	-179	-167/AA	4
Totalize Events	none rqd.	-167	6 (2280B only)

** A dc voltage scanner and companion connector Option (-162 and -176) are also required for each Transducer Excitation Option -164 used for RTDs, Ohms, or Strain measurements*

*** A/D Converter (-161) required in chassis*

Voltage, Thermocouple Current Inputs

Thermocouple and DC Scanner Option (-162)

Channels: Twenty per option. One 3-pole dry reed relay for each channel (Hi, Lo, Shield)
Ranges: 64 mV, 512 mV, 8V, and 64V, software-selectable
Input Impedance: ≥200 MΩ on 64 mV and 512 mV ranges, 10 MΩ on 8V, and 64V ranges
Thermal Offset: ≤1 μV each channel
Maximum Input Voltage: 250V dc or rms ac between Hi and Lo terminals
Maximum Common Mode Voltage: 250V dc or rms ac between Hi or Lo and ground or between two adjacent channels

Voltage Input Connector Option (-176)

Channels: Twenty 3-wire sets of screw terminals for dc voltage input wires
Maximum Measureable Voltage: 64V dc
Compatibility: Plugs onto scanner module, Option -162

DC Voltage Accuracy ±(% of Rdg + Counts)*

Range	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year** -20°C to 70°C
64 mV	0.005% + 7	0.01% + 8	0.03% + 9
512 mV	0.005% + 3	0.01% + 4	0.03% + 5
8V	0.005% + 7	0.01% + 8	0.03% + 9
64V	0.009% + 3	0.02% + 4	0.05% + 5

** Total instrument accuracy using Option -162 and -176*

*** A/D Converter must be in 2281A for operation to -20°C or 70°C*

Isothermal Input Connector Option (-175)

Channels: Twenty 3-wire sets of screw terminals for thermocouple or voltage input wires. Large, insulated aluminum block serves as reference junction
Maximum Measurable Voltage: 64V dc
Compatibility: Plugs onto scanner module, Option -162

Temperature Measurement Accuracy, Thermocouples*

Thermocouples		Accuracy [1] [3]		
Type & Range	Temperature	90 Days 15°C to 35°C	1 Year 15°C to 35°C	1 Year [2] -20°C to 70°C
J	-100 to -25	0.45	0.5	0.8
-200 to 760	-25 to 760	0.35	0.4	0.7
K	0 to 900	0.4	0.45	0.7
-275 to 1350	900 to 1350	0.52	0.65	1.3
T	-100 to 75	0.58	0.65	1.1
-230 to 400	75 to 150	0.35	0.39	0.7
	150 to 400	0.3	0.34	0.6
E	-100 to -25	0.47	0.54	0.9
-250 to 900	-25 to 750	0.3	0.33	0.6
	750 to 900	0.33	0.4	0.8
R	250 to 450	0.9	1.0	1.3
0 to 1767	450 to 1767	0.8	0.9	1.4
S	200 to 1767	0.97	1.1	1.6
0 to 1767				
B	600 to 800	1.4	1.6	1.9
200 to 1820	800 to 1820	0.96	1.1	1.3
N [4]	-100 to 150	0.6	0.7	1.1
-200 to 400	150 to 400	0.4	0.44	0.7
C	200 to 1000	0.57	0.66	0.94
0 to 2315	1000 to 2000	0.90	1.2	2.1
	2000 to 2315	1.3	1.7	2.9
JDIN	-100 to -25	0.5	0.56	0.9
-200 to 900	-25 to 900	0.4	0.45	0.7
TDIN	0 to 200	0.48	0.53	0.8
-200 to 600	200 to 600	0.37	0.41	0.7

[1] Total instrument accuracy. Includes all instrument errors such as A/D errors, scanner errors, power supply warm-up, reference junction errors, conformity errors, etc.

[2] Total Instrument Accuracy using Option -162 and -175 in 2281A chassis

[3] A/D Converter must be in 2281A for operation to -20°C or 70°C

[4] For AWG 28 wire

Current Input Connector Option (-171)

Channels: Twenty 2-wire pairs of screw terminals for current inputs. Typically for 4 to 20 mA or 10 to 50 mA inputs
Maximum Measurable Current: 64 mA per channel
Current-Sense Resistors: 8Ω ±0.02Ω
DC Current Accuracy: ±(0.25% of reading + 4 counts) for 90 days
Compatibility: Plugs onto scanner module, Option -162

AC Voltage Input Connector Option (-160)

Channels: Ten 2-wire sets of terminals for ac voltage and ten for dc voltage
Voltage Range for AC: 5V rms to 250V rms measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Frequency Range for AC: 45 Hz to 450 Hz
Accuracy for AC: 1% of reading ±0.1V for 90 days. Average-responding conversion; calibrated for rms value of sinewaves
Voltage Range for DC: 64V maximum measurable. 250V rms ac or dc maximum between any two terminals on the assembly
Accuracy for DC: Same as for Option -162 with Option -176
Compatibility: Plugs onto scanner module, Option -162

RTDs & Ohms Scanner Option (-163)

A 20-channel scanner module for precision measurements of RTDs and/or resistances.
Measurement Modes: 4-wire or one of two 3-wire modes (both with lead-wire resistance compensation). One 3-wire mode eliminates reed resistance errors
Ranges: Three; 256Ω, 2048Ω, and 64 kΩ (or user selectable), software programmed
Current Sources: Two; 1 mA and 32 μA (or user selectable)

Input Isolation: 250V dc or ac rms between separate scanner modules. 250V dc or ac rms between the two decades of channels within a scanner module. 250V dc or ac rms between all channels in two of the three measurement modes. 30V dc or 24V ac rms between terminals of a channel

RTDs & Ohms Connector Option (-177)

Plugs onto the Option -163 circuit card module. Contains five terminals per channel for 20 channels of RTD and resistance input wires.

RTD Specifications, Five Classes

A — User-defined high resolution Platinum RTDs
B — High resolution Platinum 385 DIN RTDs
C — User-defined high temperature Platinum RTDs
D — High temperature Platinum 385 DIN RTDs
E — Ten Ohm Copper RTDs

RTD Class	Maximum Temperature	System		
		Resolution	Accuracy*	Repeatability*
A	420°C	0.006°C	0.1°C**	0.04C**
B	420°C	0.006°C	0.11°C**	0.04°C**
C		0.05°C	0.27°C***	0.16°C***
D		0.05°C	0.28°C***	0.16°C***
E		0.06°C	0.3°C	0.17°C

**Total Instrument Accuracy, 15°C to 35°C for 90 days*
***RTD Temperature ≤150°C*
****RTD Temperature ≤600°C*

Note: Classes A and C allow the user to perform an ice point initialization and improve total system accuracy to be the sum of repeatability plus 0.02°C for 390 and 392 RTDs or 0.03°C for 385 DIN RTDs plus RTD conformity error

Ohms Specifications

Resolution	±(% of Rdg + Ω)	
	Accuracy	Repeatability
2.4 mΩ	0.017% + 5.7 mΩ	0.0065% + 5.7 mΩ
19 mΩ	0.017% ±38 mΩ	0.0060% ±38 mΩ
0.6Ω	0.06% ±1.22Ω	0.0075% ±1.22Ω

**Total Instrument Accuracy, 15°C to 35°C for 90 days*

RTDs, Ohms, & Strain Excitation Option (-164)

Five constant current sources for measuring RTDs and/or resistances and a constant voltage source for measuring strain. Channels are configurable in groups of four for either voltage or current excitation. These current sources are factory configured for 1 mA output and are user-modifiable for other ranges. The voltage supply is switch-selectable for either 2V or 4V and can supply up to 250 mA. A bridge completion network is provided for ½- and ¼-bridge strain gages. Requires Connector Option -174. Option -174 and -164 plug together and occupy one I/O slot in a 2280B/2285B or 2281A, usually adjacent to the corresponding Scanner Option -162, which is also required.

RTDs, Ohms, & Strain Connector Option (-174)

Channels: Twenty 5-wire sets of screw terminals for connections to RTDs or strain gages. Terminals also provide access to the bridge completion network of Option -164
Compatibility: Plugs onto excitation module, Option -164

Ohms Mode Specifications (Option -164, -174)

Max Resistance	Accuracy* ±(% of Rdg + mΩ)	Resolution	Excitation Current
64Ω	0.02% + 7	1 mΩ	1 mA
512Ω	0.02% + 30	10 mΩ	1 mA
Other ranges that may be set by user			
5.12 kΩ 51.2 kΩ	Depends on user's resistor	0.1Ω 1Ω	0.1 mA 0.01 mA

**Total Instrument Accuracy, 15°C to 35°C for 90 days*

RTD Mode Specifications (Option -164, -174)

RTD channel definitions allow you to tailor the instrument to the known characteristics of your probe with a conformity error less than 0.05°C
Resolution: 0.02°C

Temperature Measurement Accuracy*

RTD Type & Range	Maximum Instrument Error
100 Platinum RTDs	
-200°C to +200°C	0.1°C
200°C to 600°C	0.15°C
10 Copper RTDs	
-75°C to +150C	1.0°C

**Total Instrument Accuracy. For 90 days, 13°C to 33°C*

Repeatability: ±0.08°C for Platinum RTDs, ±0.2°C for Copper RTDs
Temperature Coefficient: ±10 ppm/°C

Strain Mode Specifications (Option -164, -174)

Full-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges with 2V supply or ten 120Ω bridges with 4V supply
Resolution: 0.25 microstrain
Total System Accuracy: ±(0.05% of rdg + 2 microstrain)*
Temperature Coefficient: ±10 ppm/°C

½-Bridge Strain
Capacity: Twenty 350Ω or 120Ω bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 13 microstrain)*
Temperature Coefficient: ±15 ppm/°C

¼-Bridge Strain
Capacity: Twenty bridges
Resolution: 0.5 microstrain
Total System Accuracy: ±(0.05% of rdg + 25 microstrain)*
Temperature Coefficient: ±20 ppm/°C

**20°C to 30°C for 90 days*

Frequency Measurement and Event Totalization (-167) (2280B only)

Channels: Six
Functions: Event counting and frequency measurement, selectable per channel pair
Inputs
Signal Types: TTL, CMOS, contacts, analog waveforms
Adjustments: Threshold, deadband, and debouncing
Isolation: Each group of six channels isolated from ground
Frequency Measurement: 400 kHz maximum frequency, 0.001% resolution
Event Counting
Maximum counts: 8,388,607
Counting Rate: DC to 400 kHz
Operation: Count is reset after each scan. Pseudo channels are used for count accumulation
Connector: Screw terminal connector supplied

Frequency Measurement and Event Totalization (-167/AA)

Channels: Four
Functions: Event counting and frequency, selectable by channel
Inputs
Signal Types: TTL or contacts
Adjustments: None
Isolation: Each group of four channels isolated from ground
Frequency Measurement: 1000 Hz maximum frequency, 1 Hz resolution
Event Counting
Maximum Counts: 65,534
Operation: Count is reset after each scan. Pseudo channels are used for count accumulation
Counting Rate: DC to 1000 Hz
Connector: Uses -179 Digital/Status Input Connector (not supplied)

Digital & Status Inputs & Outputs

Digital Input/Output Module Option (-168)

For controlling up to 20 input or output lines. Handles either 20 status inputs, 5 groups of 4-wire BCD digit inputs, or one 17-bit binary number (and sign). Or handles 20 status outputs.

Inputs: Zero volts or contact closures for low, +6 volts maximum for high

Common Mode Voltage: 30V rms ac or dc, maximum

Outputs: Open collector NPN transistors, diode clamped, 28V maximum, 100 mA at 1V

Compatibility: Requires connector Option -179 for inputs or connector Option -169 for outputs

Digital/Status Input Connector Option (-179)

Channels: Twenty 2-wire pairs of terminals for Option -168 plus terminals to select BCD and binary clocking format

Status Output Connector Option (-169)

Channels: Twenty 2-wire pairs of terminals for Option -168. Also terminal provided for clamping diodes when used to drive relays

Analog Option

Analog Output Option (-170) (2280B only)

Outputs: Four per module. Each output has a selectable choice of ranges: -5V to +5V, 0V to +10V, or 4 to 20 mA

Resolution: 2.44 mV in voltage ranges, 3.9 μA in current range

Accuracy: ±0.1% of range for 90 days, 15°C to 35°C

Isolation: Each group of four channels isolated from ground

Compliance Current: 5 mA in voltage mode

Compliance Voltage: 10V in current mode

Temperature Range: -20°C to +70°C, operating in 2281A

Connector: Included with option

Other 2280 SERIES Options

RS-232-C Interface Option (-341)

Data may be output via the RS-232-C interface at 110 to 19,200 baud, selectable from the front panel. May be configured to operate on a 20 mA current loop and can serve as the 20 mA current source.

Other RS-232-C parameters selected via the front panel include: Data compression format, channel readings per line, start of data sequence, end of data sequence, line termination sequence, and parity.

Acts as a terminal (DTE) or, with an included adapter, as a modem (DCE), or both (with two Options).

Baud: 110, 300, 600, 1200, 2400, 4800, 9600, or 19,200

Parity: Odd, even, or neither

IEEE-488 Interface Option (-342)

Operates as either a talker only, or talker/listener. Easy-to-read thumbwheel switches are used to set the IEEE-488 address and are accessible from the rear panel. Data output parameters selected from the front panel include data compression format and the number of channel readings per line.

Repertoire In Port A: SH1, AH1, T5, L4, SR1, RL1, DC1, E2

Repertoire in Port B: SH1, AH1, T5, L4, SR1, and E2

2281A Power Supply Option (-431)

Although power for a 2281A is normally supplied by a 2280B/2285B via a 2281A-402 Cable, a built in power supply Option (2281A-431) is available and is required when the distance to a 2281A and/or the current drain of the 2281A is heavy because of the number of options installed. The 2281A-431 power supply will operate on ac power or a 12V or 24V dc supply, either of which will trickle charge a 12V battery for battery backup in the event of a power failure. Ask your Fluke Sales Office or Representative for Configuration Form F605 to determine what options may be installed in a 2281A at what distances without Option 2281A-431.

Operating Temperature: -20°C to +70°C

2280 SERIES Accessory Descriptions

Y2042: Package of five DC 100 tape cartridges certified for use with Tape Drive Unit (Option -214).

Y2044: Rack Slide Kit for mounting 2280 Series or 2281A in a standard 42-cm (19-inch) rack with 61-cm (24-inch) depth. Contains all necessary hardware including a Y2045. Height is 22.2 cm (8.75 in).

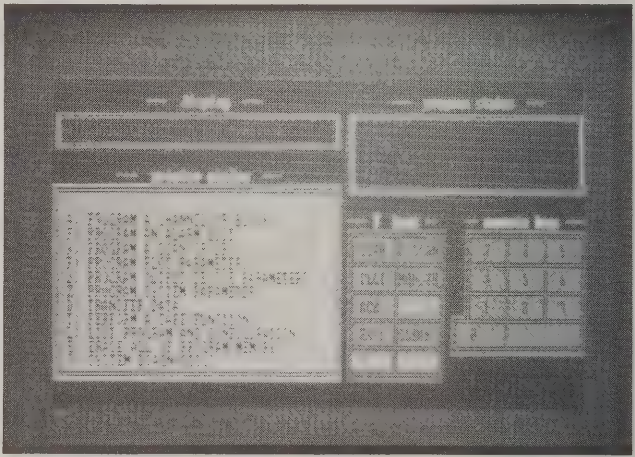
Y2045: A rack mounting kit for 2280 Series or 2281A. Does not include rack slides. Fits standard 42-cm (19-inch) rack with 61-cm (24-inch) depth. Height is 22.2 cm (8.75 in).

Y2046: Package of ten rolls of thermal print paper for 2280B/2285B's printer/plotter. Capacity is 4000 lines of print, 12,000 channel readings using compressed mode.

Y2047: Three-connector device needed for "star" configurations.

A22-300: A heavy-duty transit case constructed from high-density polyethylene specifically for the 2280B/2285B. Foam padding, cut to conform to the 2280B/2285B mainframe, insulates the data logger from shock encountered in shipping. Dimensions: 30.5 cm H x 64 cm W x 76.8 cm D (12 in x 25.1 in x 30.1 in).

A22-301: A tape reader compatible with the 2280B's DC 100 tapes. It will output data via RS-232-C (110-9600 baud), or 20 mA current loop, 115 or 230V, 50 Hz or 60 Hz power.



ProLogger Software

- For use with an IBM-PC and the Fluke 2280 Series Data Loggers
- Accommodates full operation of the 2280B or 2285B from the IBM-PC
- Transfers data from the 2280 Series to disk in Lotus 1-2-3 format

ProLogger Software is a tool which links the IBM-PC, XT, or AT with a Fluke 2280 Series Data Logger to form a powerful data collection and analysis system. This package emulates the 2280 Series' front panel on the screen of the IBM, and allows the user to program the data logger through the same menu prompting that is available on the 2280 Series itself. Other utilities allow the user to transfer data to a disk in Lotus 1-2-3 format or ASCII, upload data from the 2280B's option -214 Cartridge Tape Drive, download programs from disk on the IBM-PC to the 2280 Series, and perform any other functions that can be accomplished from the 2280 Series' front panel.

The IBM-PC must have a serial interface, graphics card, and MS-DOS 2.1 or higher. A color monitor is not a necessity, but will enhance the appearance of ProLogger. The 2280 Series Data Logger must have a -341 RS-232-C Interface Option.

Models

January 1986 prices

2280B Data Logging System	$6995
2285B Data Logger	4995
2281A Extender Chassis	800

2280 SERIES Options

2280A-160 AC & DC Input Connector	275
2280A-161 High Performance A/D Converter	800
2280A-162 Thermocouple & DC Voltage Scanner	625
2280A-163 RTD & Ohms Scanner	995
2280A-164 RTD, Ohms, Strain Excitation	620
2280B-167 Counter/Totalizer, 6 Channel	900
2280A-167/AA Counter/Totalizer, 4 Channel	on req.
2280A-168 Digital or Status Input/Output	700
2280A-169 Status Output Connector	100
2280A-170 Analog Output	995
2280A-171 Current Input Connector	200
2280A-174 Transducer Excitation Connector	375
2280A-175 Isothermal Input Connector	175
2280A-176 DC Voltage Input Connector	100
2280A-177 RTD, Ohms Connector	200
2280A-179 Digital/Status Input Connector	100
2280A-211* Advanced Math Processor	1200
2280A-214* DC 100 Tape Drive Unit	1900
2280A-341 RS-232 Interface	990
2280A-342 IEEE-488 Interface	990
2281A-402 Connecting Cable (per meter)	4
2281A-403 Connectors for Option -402	95
2281A-431 Power Supply for 2281A	495

**Factory or Service Center installation only. Others user-installable*

2280A SERIES Accessories (Also see page 230)

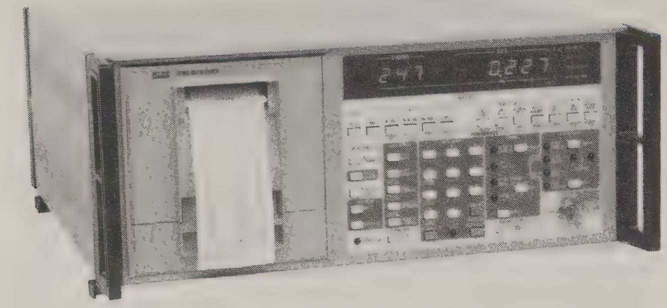
Y2042 Pack of 5 DC 100 Cartridges	130
Y2044 Rack Slide Kit and Rack Mount Kit	195
Y2045 Rack Mount Kit	120
Y2046 Pack of 10 Rolls Printer Paper	50
Y2047 Extender Chassis Multi-Connector	75
A22-300 Transit Case for 2280A	on req.
A22-301 Tape Reader for DC 100 Tapes	on req.

After-Warranty Service (See page 227)

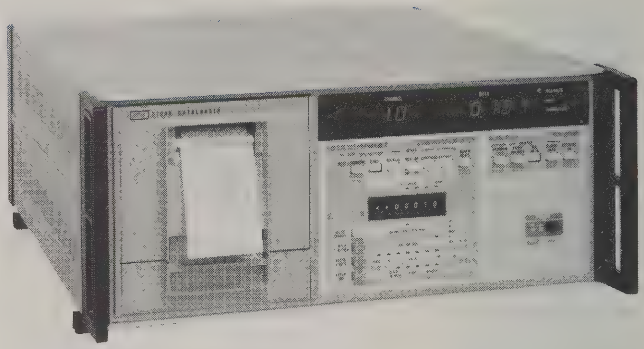
A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

DATA LOGGERS

2240C/2200B



2240C



2200B

2240C Data Logger

- Expandable to 1000 channels
- Easy to configure and program
- Input and log thermocouples, RTDs, DCV, ACV, dc current, and BCD
- Up to 4 user-programmed alarms per channel
- Remote control via IEEE-488 or RS-232-C

The 2240C sells for a mid-range price yet it handles most data logging requirements. A large variety of options makes it possible to configure each system to closely match the size and unique character of individual requirements. Programming is accomplished from the front panel or from a remote computer via an RS-232-C or IEEE-488 interface. You can scan and record all data, record data only when an out-of-limit transition occurs, or record data periodically at preselected intervals. Data is displayed on the front LED panel, and can be written to the built-in printer or to an external device.

Specifications

Mainframes: One 2240C per system; as many 2201A, 2202A and/or 2203A Extender Chassis as needed for scanning more than 60 channels
Maximum Analog Inputs: ≤1000 per system

2240C Mainframe
Capacity: Six slots for input options plus 3 slots for digital input, alarm output, and communications options

2200B Data Logger

- Lowest cost data logger
- Expandable to 100 channels
- Easy to program
- Input and log thermocouples, RTDs, DCV, ACV, dc current, and BCD
- Up to 4 user-programmed alarms per channel
- Output via IEEE-488 or RS-232-C

The 2200B is recommended for comparatively simple data logging operations. It will scan up to 60 input channels as a stand-alone instrument and up to 100 channels if connected to an Extender Chassis. Included in the price of each 2200B is a scanner card option (-06) and a mating connector option (-08) that will handle up to 10 DC voltage or thermocouple inputs. Also included is an A-to-D converter circuit card and the capability to linearize up to four different combinations of thermocouples, RTDs, and/or current transmitter inputs (from a list of 15). Data can be retrieved from the LED display panel, from the internal printer or from an external device.

Specifications

Mainframes: One 2200B per system, plus one Scanner Extender if more than 60 channels must be scanned
Maximum Inputs: ≤100 per system

2200B Mainframe
Capacity: Six slots for input options plus 3 slots for digital input, alarm output and communications options. One -06 with -08 is supplied

Common Specifications (2240C & 2200B)

2201A Scanner Extender

Capacity: 12 slots for scanner cards (120 channels). 2201A only needed if more than six scanner cards (60 channels) are required

2202A Remote Scanner Extender With Power Supply

Capacity: 10 slots for scanner cards (100 channels)

2203A RTD Extender With Power Supply

Similar to 2202A except for RTDs only. A 1.8 meter cable is standard.

High Performance A/D Converter
Dynamic Range: 40,000 counts
Ranges: ±40 mV, ±400 mV, ±4V, and ±40V
Resolution: 1 µV on 40 mV range
Common Mode Noise Rejection: ⩾140 dB at 50 and 60 Hz ±0.1%

DC Voltage Accuracy: ±(%Rdg + Volts)*
2240C and 2200B

	90 Days 20°C to 30°C		1 Year 20°C to 30°C	
Range	2.5 Rdgs/Sec	15 Rdgs/Sec	2.5 Rdgs/Sec	15 Rdgs/Sec
40 mV	0.01+3 µV	0.01+4.2 µV	0.015+6 µV	0.015+10 µV
400 mV	0.01+21 µV	0.01+33 µV	0.015+42 µV	0.015+64 µV
4V	0.01+0.2 mV	0.01+0.32 mV	0.015+0.4 mV	0.015+0.6 mV
40V	0.01+2 mV	0.01+3.2 mV	0.015+4 mV	0.015+6 mV

Total Instrument Accuracy, using Option -06 and -08.

2240C & 2200B Input Options

For These Inputs	Use Connector Option	With Scanner Option	Maximum Inputs Per Scanner
Thermocouples* & Low DC Voltage	-08**	-06**	10
Low DC Voltage	-07 or -08	-06	10
DC Voltage	-07 or -08	-05 or -06	10
AC Voltage	-07 or -08	-33/AL	8
1-5 mA DC	-28	-05 or -06	10
4-20 mA DC	-29	-05 or -06	10
10-50 mA DC	-30	-05 or -06	10
RTDs*	-03	-04***	10
RTDs	-03	-33	8
BCD Digits	None	-16	9

**Linearization Option -43, -44, or -45 required if using 2240C*
***One included with each 2200B*
****For 2203A RTD Scanner Chassis*

Low Level Scanner Option (-06)

Ten channels/option. For thermocouple/low input voltage applications. Three-wire relay scanner, less than 1 µV offset

General Purpose Scanner Option (-05)

A 10-channel, two-wire relay scanner for DC input applications.

Solder Pin Connector Option (-07)

A 30-pin card-edge connector. Each three-wire input is soldered directly to the connector pins. Compatible with Option -05 or -06

DC Current Connector Options (-28, -29, -30)

Option -28 is for 1 to 5 mA current transmitters.
Option -29 is for 4 to 20 mA current transmitters.
Option -30 is for 10 to 50 mA current transmitters.

AC Voltage Scanner Option (-33/AL)

An 8-channel scanner card with two switch selectable voltage ranges: 4V and 120V rms. Requires Connector Option -07 or -08.

RTD Scanner Option (-04)

A 10-channel scanner which operates only in a Model 2203A RTD Scanner Chassis. Up to 10 scanners can be installed in a single 2203A.

RTD Scanner Option (-33)

Eight channels per option. Operates in 2240C, 2201A, 2200B or 2202A.

RTD Connector Option (-03)

A card-edge connector assembly which plugs onto an RTD Scanner Option.

Digital Input Option (-16)

A circuit card which accepts up to nine digits of BCD input data for display as supplementary heading data.

Other 2240C & 2200B Options

Option	Description	Used With 2240C	Used With 2200B
Temperature Linearization & Scaling			
-11*	Thermocouples, RTDs, Current	No	Yes
-43	Group I (T/Cs: J,K,T,S,R,B,E,C; RTDs: 385, 390 Pt, 0-100%)	Yes	No
-44	Group II (T/Cs: J,K,T,S; J_{DIN}, K_{DIN}, T_{DIN}, S_{DIN}; RTDs: 385, 392 Pt, 0-100%)	Yes	No
-45	Group III (T/Cs: J,K,T,S,N,D,G; RTDs: 385 pt, 120Ω Ni, 10Ω Cu, 0-100%)	Yes	No
Scaling & Conditioning			
-40	mx+b Scaling	Yes	No
-26	Multiple-Scaling	No	Yes
-27	Engineering Units Notation	No	Yes
-42	Data Averaging	Yes	No
-32	Dual Interval Scan	Yes	No
Limits & Alarms			
-41	Alarms Setpoints (60 setpoints)	Yes	No
-34	Alarms Setpoints (40 setpoints)	No	Yes
-23	Alarms Outputs	Yes	Yes
Communications Interfaces			
-12	RS-232-C (Outputs only)	Yes	Yes
-14	Magnetic Tape	Yes	Yes
-37	IEEE-488 (Outputs only)	No	Yes
Remote Programmable Interfaces			
-15	IEEE-488	Yes	No
-17	RS-232-C	Yes	No

**Included with each 2200B. Choose four items from list for Options -43, -44, or -45.*

2240C & 2200B Accessory Descriptions

2200A-7001: Remote Scanner Cable Connector and assembly. A required part of connecting cable assembly for Model 2202A Scanner Chassis.
2200A-7002: Remote Scanner Chassis Cable. A required part of connecting cable assembly for Model 2202A Scanner Chassis. Requires -7001 above.
2200A-7003: Standard Scanner Adapter. One required for each Option -05 or -06 Scanner circuit card installed in Model 2203A RTD Scanner Chassis.
2200A-7005: Extender Cables. A set of two extender cables for servicing vertical plug-in pcb's.
2200A-7006: General Purpose Interface Cable. For Option -16 and Option -23.
2010A-7013: Fan-fold printer paper, (one dozen packages)
2010A-7014: Printer ribbon in two colors (red and black), (one dozen)
M07-205-600: 7-inch Rack Adapter. For 2200B or 2240C Data Logger or 2201A, 2202A, or 2203A Extender Chassis.
M00-260-610: 18-inch rack slides and hardware.
M00-280-610: 24-inch rack slides and mounting hardware.
A22-6: Roll Paper Adapter. Adapts 2200B or 2240C front panel printer to use standard adding machine roll paper.

DATA LOGGERS

2240C/2200B

Models

	January 1986 prices
2240C Data Logger	6595
2200B Data Logger, w/-06 and -08	3995
2201A Scanner Extender Chassis	1645
2202A Remote Scanner Chassis	1975
2203A RTD Scanner Chassis	2575

2240C & 2200B Options

2200A-03 RTD Connector	115
2200A-04 RTD Scanner	545
2200A-05 General Purpose Scanner	295
2200A-06 Low Level Scanner	355
2200A-07 Solder Pin Connector	60
2200A-08 Isothermal Block Connector	145
2200A-12B Interface for ASR33	1260
2200A-12M Interface to RS-232-C Modems	1260
2200A-14G Interface for Kennedy 1600/360, 1610/360	1330
2200A-16 Digital Input (BCD)	510
2240A-23 Alarm Set Point Outputs	440
2240A-28 Connector for 1 to 5 mA Transmitters	230
2240A-29 Connector for 4 to 20 mA Transmitters	230
2240A-30 Connector for 10 to 50 mA Transmitters	230
2240A-33 Interchangeable RTD Scanner	500
2240A-33/AL AC Voltage Scanner	on req.

**Factory or Service Center installation only. Others user-installable*

2240C (only) Options

2240B-15 IEEE Interface	1450
2240B-17A Remote Control, RS-232-C, Modem	1315
2240B-17B Remote Control, RS-232-C, Terminal	1315
2240B-17C Remote Control, 20 mA Loop, TTY	1315
2240B-32* Dual Interval Scan	395
2240C-40* mx+b Scaling	195
2240C-41* Alarm Set Point	380
2240C-42* Time and Group Average	200
2240C-43* Temperature Scaling Group I	320
2240C-44* Temperature Scaling Group II	320
2240C-45* Temperature Scaling Group III	320

**Factory or Service Center installation only. Others user-installable*

2200B (only) Options

2200B-26* Multiple Scaling	485
2200B-27* Engineering Units Notation	180
2200B-34* 40 Alarm Limit Set Points	835
2200B-37* IEEE Interface	1520

**Factory or Service Center installation only. Others user-installable*

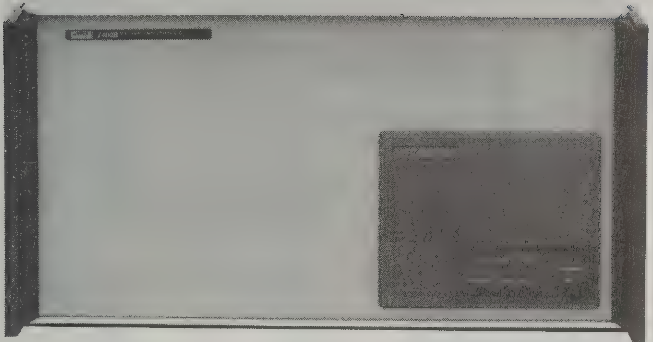
2240C & 2200B Accessories (Also see page 230)

2200A-7001 Cable Connector & Assembly	180
2200A-7002 Remote Scanner Cable (per foot)	6
2200A-7003 RTD-to-Standard Scanner Adapter	65
2200A-7005 Extender Cable	275
2200A-7006 Digital Input/Alarm Output Cable	200
2200A-12/AG Remote Start	on req.
2200A-16/AA Battery Backed-Up Clock	on req.
2010A-7013 Fan-fold Printer Paper (12 packets)	35
2010A-7014 Printer Ribbon (12 spools)	35
2240A/ACK Crystal Oscillator	on req.
M00-260-610 18" Rack Slides	105
M00-280-610 24" Rack Slides	110
M07-205-600 7" Rack Adapter	105
A22-6 Printer Roll Paper Adapter	on req.
A22-148 Tandberg BDL-3000 Cartridge Recorder (RS-232-C)	on req.
A22-150 Tandberg GPIB-3000 Cartridge Recorder (IEEE-488)	on req.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

2400B Intelligent Computer Front End



2400B

2400B Intelligent Computer Front End

- Handles nearly any I/O requirement with an extensive selection of options
- Modularly expandable (over 3000 total channels) to meet future application demands
- High accuracy analog measurements — even in electrically noisy environments
- Interface to nearly any computer via RS-232-C, RS-422, IEEE-488, or current loop
- Self documenting, structured program language — optimized for measurement and control
- A data acquisition "computer" unto itself — measures, alarms, and controls independent of host
- EPROM program storage available for stand-alone dedicated applications

The 2400B Intelligent Computer Front End is a very accurate microprocessor-based analog and digital data acquisition system with programmable control output signals. The system serves as an interface between a computer and both the measurement and control of a physical process.

The 2400B can receive a measurement and control program (up to 28K bytes) from the host computer and, upon command, execute it without further interaction with the computer. This intelligent system relieves the host of routine, time consuming tasks and greatly simplifies the programmer's task of developing system software. Cost savings is the result, and greater throughput is possible because the computer can perform other tasks at "computer speed" without waiting for physical events.

The 2400B works well in applications requiring a *distributed* data acquisition and control system. With a Serial Interface Option (-001) 2400Bs may be located over 1220 meters (4000 feet) from the host computer in a star or daisy chain configuration.

Computers with which the 2400B will interface are those with either RS-232-C, RS-422, IEEE-488, or 20 mA current loop compatibility. The Fluke 1752A Data Acquisition System interfaces well with the 2400B and the combination (called a 2452MCS) is described in the preceeding pages.

Hardware costs are reduced by having a wide range of user-configurable, input and output plug-in circuit cards plus different types of extender chassis and interface options to perform the necessary measurement and control functions of your application. The 2400B has a maximum system capacity of over 1000 analog inputs, 1000 digital inputs, 128 analog outputs, and 1000 digital outputs.

Inputs

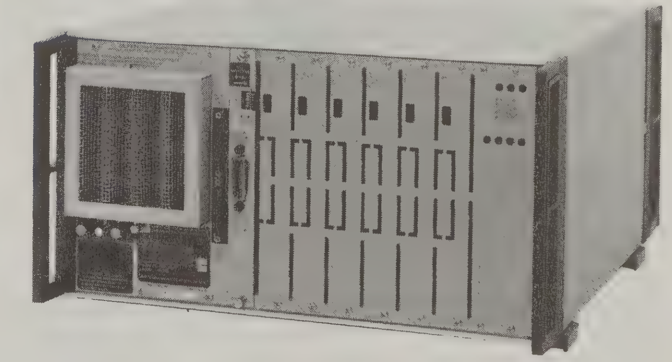
The 2400B accepts inputs from a wide variety of sources and transducers. For analog inputs, the 2400B uses its 17-bit analog-to-digital converter to perform accurate measurements of ac or dc voltage, current, or temperature using thermocouples. Integral signal conditioners are used in conjunction with the A-to-D converter to perform measurements of resistance, temperature (RTDs), and strain, or certain other transducers.

Built-in linearizations are available for a wide variety of thermocouples. RTD linearizations are software-selectable by individually programming the parameters for different probes, assuring best possible accuracy.

Totalizing, as well as frequency, period, and rotation speed measurements, are performed with one of the Counter/Totalizer Options. To sense switch closures or logic levels, you may use the Status Input Option. Or, for faster response, use the Interrupt Input Option or the Sequence of Events Recorder Option. The Interrupt Option causes the 2400B to respond to fast-changing events immediately while the Sequence of Events Option records events with up to 0.1 millisecond resolution. The Digital Input Option is used to read either 7-digit BCD or 24-bit binary words from devices with that output capability.

Outputs

The 2400B makes use of five different control output options. To light annunciators, or perform on-off control, use the Status Output Option or the Relay Output Option. Use the 2400B's other output cards for more complex process control. A Resistance Output Option may be programmed to supply output resistances from 0 to 100,000 ohms. For -10V to +10V dc or 4 to 20 mA control loops, or driving analog recorders, use the Analog Output Option. To control stepper motors, use the Stepper Motor Output Option. Frequency and acceleration or deceleration rates may be selected through the 2400B's software for stepper motor control.



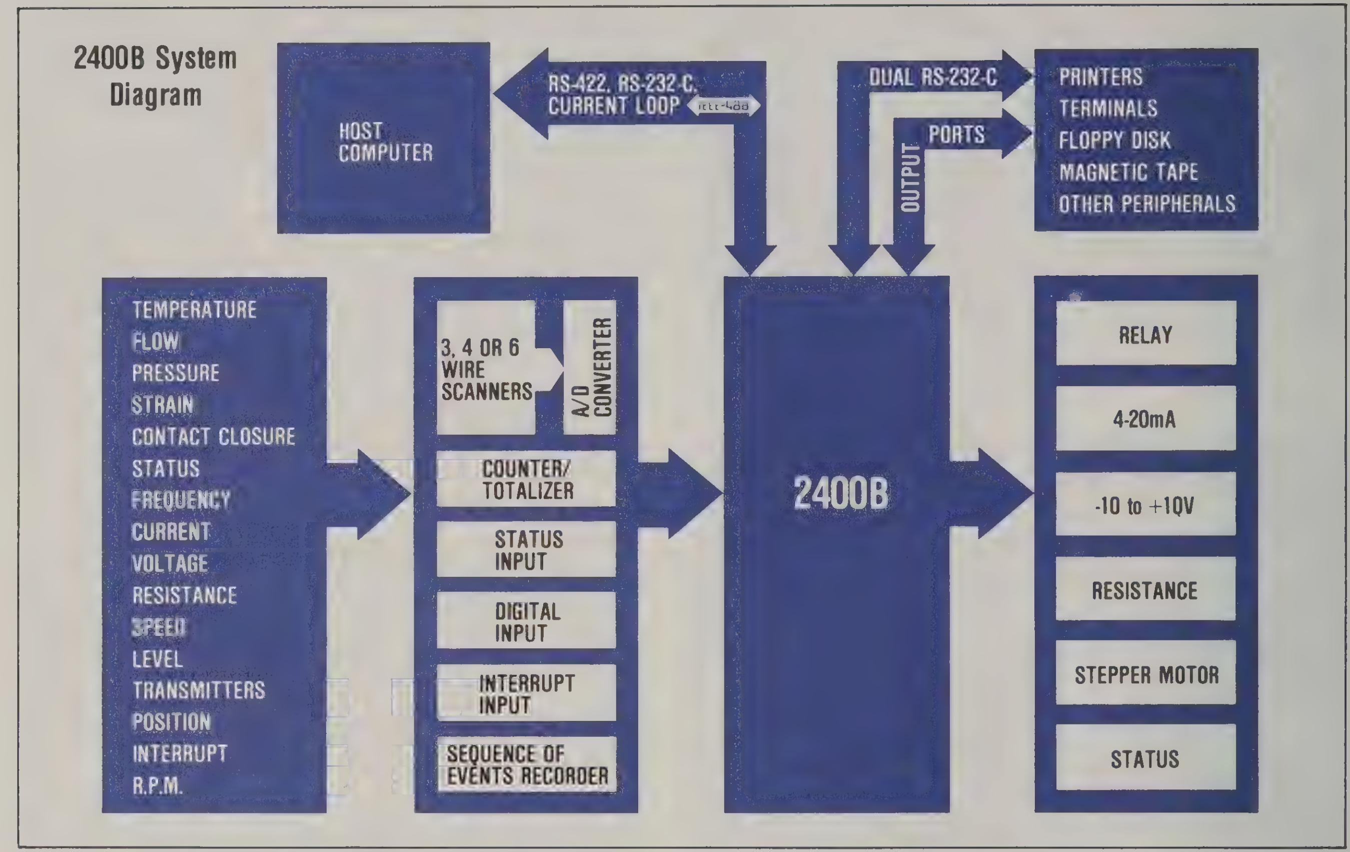
2400B rear panel showing optional IEEE-488 interface and dual RS-232-C output only ports.

Expandability

A 2400B system may be large or small, depending upon the application. The 2400B mainframe has six slots for any combination of input, output, or interface plug-in modules. To expand the system, just add extender chassis. However, only one A-to-D converter is needed for a 2400B system to measure analog signals, even if the maximum number of channels is installed.

Several 2400Bs may be interfaced to a single computer. When equipped with either the RS-422, or 20 mA current loop interface, 2400Bs may be arranged in a multi-drop configuration at distances up to 1220 meters (4000 feet) from the host computer. Greater distances are possible utilizing the 2400B's RS-232-C interface and modems, over existing telephone lines.

2400B Intelligent Computer Front End


2400B System Diagram

Flexible Software

The 2400B can be utilized with two "levels" of software. The first level is for immediate-mode commands, those which cause an immediate response from the 2400B. The second level is the program stored in the 2400B, allowing the 2400B to monitor and measure inputs, perform calculations, make decisions, and set control outputs, all independent of the host computer.

Immediate Mode

Immediate-mode (host) commands cause an immediate response in the 2400B. For instance, if the host computer tells the 2400B to:

```
SEND AI(16)!
```

the 2400B will perform a reading on analog input channel 16 and return the result to the host computer. (Immediate-mode commands end with the "!" character). The command

```
AO(0)=0.155*AI(2)-1.2!
```

will cause the 2400B to read Analog Input channel 2, multiply it by 0.155, subtract 1.2 and set Analog Output channel 0 to that value.

To gain maximum flexibility from the 2400B's wide range of input and output options, the definition-bus command is used (DEFN). To define analog input channels 10 through 29 as type "J" thermocouples, you would send the 2400B the following command:

```
DEFN
  AICHAN=10 TO 29,SENSOR=TC,TYPE=JNBS;
!
```

This command, however, differs from the previously discussed commands: It is stored in the 2400B's memory, and is used whenever readings on channels 10 to 29 are requested. So, when the command

```
SEND AI(11)+AI(15)!
```

is sent to the 2400B, the measurements (complete with autozero, range selection, and thermocouple linearization) would be performed on analog inputs 11 and 15, returning the sum to the host in degrees Celsius.

Stored Program Operation

The second level of 2400B software is the stored program, a set of instructions downloaded to the 2400B at start-up. This program allows the 2400B to operate independently, with only occasional communication with the host computer. A full set of mathematical functions enables the 2400B to perform complex linearizations, data averaging, proportional integral derivative loops, and more, on its own.

The "IF-THEN-ELSE" statement allows conditional execution of statements or program segments. LOOP and AGAIN statements allow repeated execution of program tasks. The command

```
SCAN POINTS(0), 0 to 199;
```

reads channels 0 to 199 in accordance with their respective definitions with a single instruction, avoiding the necessity of writing a complete subroutine — often necessary in other less intelligent systems.

Experienced programmers will appreciate the modularity and readability added to programs due to function and procedure (subroutine) constructs. Procedures may be called directly from the stored program or invoked by external or time-triggered interrupts.

Since the stored program is resident in the 2400B itself, communications to the host computer are minimized or non-existent. This results in less complex programs, as well as faster execution speeds. For example, the following simple program performs a complete proportional control loop with limit checking:

```
PROG
SETPT=150;
LIMIT=185;
OFFSET=7.5;
GAIN=0.15;
LOOP;
    TEMP=AI(10);
    IF TEMP >LIMIT THEN SO(6)=1;
    AO(4)=GAIN*(TEMP-SETPT)+OFFSET;
AGAIN;
!
```

In this program, the LOOP and AGAIN cause repeated execution of the three statements nested inside them. The first of these stores the reading on analog input channel 10 in the variable TEMP. If the DEFN statement shown above had been sent to the 2400B prior to execution of this program, this reading would have been in degrees Celsius. Next, the second statement checks to see if the temperature is above the limit. If so, status output 6 will be set to one, which could ring a bell, for instance. Finally, analog output 4 would be set to the voltage computed in the formula.

While this program is executing, a bus command can be used to alter any of the variables used in the program. For instance, the command SETPT=155! could be used to change the setpoint. This capability allows interactive reprogramming of the 2400B, while the 2400B continues program execution.

Stand-Alone Capability

By loading the 2400B's stored program into EPROMs in the mainframe, the 2400B can be used to monitor inputs, perform calculations, and update control outputs, without being connected to a host computer. Using one or both of the 2400B's RS-232 ports in conjunction with the Fluke 1780A InfoTouch® Display allows stored program data to be presented and modified by an operator, all under the program's control. Approximately 400 lines of 2400B program may be stored in EPROM.

Worldwide Support

Service centers for Fluke products are located in more than forty countries around the world. Many offer full service contracts for maintenance and repair at your site. Or training for your personnel can be arranged. We know how important it is to be assured of expert maintenance for systems you depend on, even though they may be among the most troublefree available — like those from Fluke.

Specifications

Analog Inputs: ≤1000 isolated, 3-, 4-, or 6-wire channels
Digital Inputs: ≤1024 non-isolated lines, configurable for either (1) 7 BCD digits plus 1 sign bit plus 3 bits for decimal point location or (2) 24-bit binary plus 1 sign bit
Status Inputs: ≤1024 electrically isolated wire-pairs
Interrupt Inputs: ≤32 electrically isolated wire pairs
Counter-Totalizer Inputs: ≤32 isolated analog and ≤32 non-isolated TTL inputs
Status Outputs: ≤1024 electrically isolated wire-pairs
Analog Outputs: ≤128 voltage and/or current sources in range of -10V to +10V or 0 to 20 mA
Resistance Outputs: ≤64 resistance sources with 1Ω increments to 4095Ω and/or 25Ω increments to 102,375Ω
Stepper Motor Outputs: ≤32 direct or logic level outputs

2400B Mainframe

The 2400B must have either option -001 or Option -002 installed to be operational.

Capacity: Six slots for any combination of input, output, or extender chassis interface plug-in modules. A-to-D converter module (Option -109) installed in a dedicated additional slot
CPU: 16-bit microprocessor, 32K-byte EPROM, 28K-byte user-partitioned RAM
Serial Outputs: EIA Standard RS-232-C, two ports, output only

Serial Interface Option (-001)

Bi-directional serial interface to compatible host computer. This option is configurable as either an RS-232-C, RS-422, or 20 mA current loop via a changeable jumper. As an RS-232-C interface, Option -001 supports five protocols. Listed in order of increasing level of error detection capability they are

- Simple terminal
- Simple terminal with XON/XOFF
- Simple terminal with XON/XOFF and timeout
- Blocked format with acknowledgements
- Blocked format with acknowledgements and check character

IEEE-488 Interface Option (-002)

Bi-directional IEEE-488 interface to compatible host computer or instrument controller such as Fluke 1722A.

2401A Scanner Extender Chassis

Capacity: Ten scanner modules (Option -101, -115, or -117) 100 analog input channels. Option 2401A-401 required
System Size: Ten 2401As maximum
Maximum Distance: 15 meters (50 feet) from 2400B or 2403A
Power: From 2400B or 2403A

2402A I/O Extender Chassis

Capacity: 12 input and/or output plug-in modules. Option 2402A-501 required
System Size: 16 2402As, maximum
Maximum Distance: 15 meters (50 feet) from 2400B
Power: Line power required

2403A Remote A/D Extender Chassis

Capacity: Eight slots for signal conditioners, scanner modules (Option -101, -115 or -117) plus two slots for Interface Options (-401) for up to ten 2401s. One A/D module required (Option -109). Option 2403A-601 also required
Maximum Distance: 1220 meters (4000 feet) from 2400B
Power: Line power required

High Performance A/D Converter Option (-109)

Required for all analog measurement inputs. Only one allowed for each 2400B System.
Input Resistance: >200 MΩ in 0.1V, 0.8V, and 6.4V range; 10 MΩ in 100V range
Input Capacitance: 0.005 μF at 25 readings per second; 0.5 μF at 3 readings per second
Zero Stability: Automatically zeroed before each measurement
Overrange: Autoranges, unless autorange defeated. Overload causes front panel ERROR light to turn on and message available to host computer

Voltage, Current, Thermocouple Inputs

High Performance Scanner Option (-101)

Ten 3-wire dry reed relays (Hi, Lo, shield).
Life: Rated for $>10^8$ operations with ≤50V ac rms applied; $>10^7$ operations with ≤250V ac rms applied
Thermal Offset: <1 μV per channel
Maximum Voltage: 350V dc or peak ac between any input terminal and system ground or other terminal

Thermocouple and DC Voltage Input Connector Option (-102)

Ten 3-wire sets of screw terminals on isothermal block enclosed in a snap-apart plastic safety housing. Integral reference junction correction for 0°C. Plugs into Scanner Module (Option -101).

Temperature Resolution: 0.1 degree (one count).

2400B Intelligent Computer Front End

Temperature Measurement Accuracy

Measurement may be performed in Celsius, Fahrenheit, Kelvin, or Rankine

Thermo-couple Type	Measured Temperature °C	Maximum Instrument Error (±°C)*					
		24 Hours 21°C-25°C Rdgs/Sec		90 Days 18°C-28°C Rdgs/Sec		1 Year 13°C-33°C Rdgs/Sec	
		3	25	3	25	3	25
J	-200 to +200	0.2	0.3	0.25	0.35	0.3	0.4
NBS	+200 to +760	0.2	0.3	0.35	0.45	0.4	0.5
K	-225 to +200	0.2	0.3	0.25	0.35	0.3	0.4
NBS	+200 to +1350	0.2	0.3	0.4	0.5	0.5	0.6
T	-230 to +200	0.2	0.3	0.25	0.35	0.3	0.4
NBS	+200 to +400	0.2	0.3	0.25	0.35	0.3	0.4
E	-250 to +250	0.2	0.3	0.25	0.35	0.3	0.4
NBS	+250 to +1000	0.2	0.3	0.35	0.45	0.5	0.6
R	0 to +200	0.4	0.65	0.9	1.15	1.1	1.35
NBS	+200 to +1767	0.4	0.65	0.7	0.95	0.9	1.15
S	0 to +200	0.4	0.65	0.9	1.15	1.1	1.35
NBS	+200 to +1767	0.4	0.65	0.7	0.95	0.9	1.15
B NBS	+200 to +1820	0.4	0.75	0.7	1.05	0.9	1.25
J	-200 to +200	0.2	0.3	0.25	0.35	0.3	0.4
DIN	+200 to +900	0.2	0.3	0.35	0.45	0.4	0.5
T	-200 to +200	0.2	0.3	0.25	0.35	0.3	0.4
DIN	+200 to +600	0.2	0.3	0.25	0.35	0.3	0.4
R	0 to +200	0.4	0.65	0.9	1.15	1.1	1.35
JIS	+200 to +1770	0.4	0.65	0.7	0.95	0.9	1.15
N**	-200 to +200	0.2	0.3	0.25	0.35	0.3	0.4
NBS	+200 to +1300	0.2	0.3	0.4	0.5	0.5	0.6
C***	0 to +2315	0.4	0.55	0.7	0.85	0.9	1.05

** Includes all but sensor error: Connector gradient, reference junction, linearization conformity, A-to-D conversion, temperature coefficient, time drift, scanner offset.*
*** Nicrosil/Nisil*
**** Hoskins Mfg. Co. Tungsten - 5% Rhenium vs Tungsten - 26% Rhenium*

DC Voltage Input Connector Option (-108)

Ten 3-wire sets of screw terminals for input wires enclosed in snap-apart plastic safety housing. Plugs into scanner module (Option -101)
Range: -100V to +100V
Maximum Voltage: 350V dc or peak ac. See Option -101
DC Voltage Measurement Accuracy:±(% Rdg+Counts+μV)*

Readings per sec	24 Hours 21°C to 25°C	90 Days 18°C to 28°C	1 Year 13°C to 33°C
0.1V, 0.8V, 6.4V Ranges			
3	±(0.002%+2+2)	±(0.005%+3+2)	±(0.01%+4+6)
25	±(0.002%+4+4)	±(0.005%+5+4)	±(0.01%+6+6)
100V Range			
3	±(0.008%+2+0)	±(0.01%+3+0)	±(0.02%+4+0)
25	±(0.008%+4+0)	±(0.01%+5+0)	±(0.02%+6+0)

**After 45 minute warm-up. With Option -109, -101, and -108 (or -102)*

AC Voltage Input Connector Option (-119)

Ten sets of 2-wire screw terminals for input wires enclosed in snap-apart safety housing. Plugs into scanner module (Option -101).
Voltage Range: 5V rms to 250V rms
Frequency Range: 45 Hz to 450 Hz
Conversion Method: ½-wave, average-responding, calibrated to indicate rms value of sinewave
Maximum Voltage: 250V rms or 250V dc
Accuracy: ±(1.0% of input +0.1V)

Current Input Connector Option (-106)

Specifications are the same as for Option -101 but with a precision 15Ω, 0.25 watt resistor in each channel to convert current to voltage. For 4 to 20 mA sources; 129 mA maximum. Plugs into Scanner Module (Option -101). Some other current values available on request.

RTD's, Ohms, ¼-Bridge Strain Inputs

Ohms Mode Specifications

Max Resistance	Resolution	Excitation Current
64,000Ω	1.0Ω	100 μA
8000Ω	0.1Ω	100 μA
800Ω	0.01Ω	1 mA
100Ω	0.001Ω	1 mA
10Ω	0.0001Ω	10 mA

Total System Accuracy: For 90 days, 18°C to 28°C, at 25 readings per second —
Four-Wire: ±(0.021% of reading + 0.01% range)
Three-Wire: ±(0.021% of reading + 0.02% range + 0.21Ω)

RTD Mode Specifications

Resolution: 0.03°C
Total System Accuracy: For 90 days, 18°C to 28°C, at 25 readings per second, 4-wire —
100Ω Pt RTD with alpha = 0.00385: ±0.2°C at 0°C; ±0.3°C at 600°C

¼-Bridge Strain Mode Specifications

Total System Accuracy*
350Ω Gage: ±(0.042% of reading + 14 microstrain)
Resolution: 0.2 microstrain
120Ω Gage: ±(0.042% of reading + 16 microstrain)
Resolution: 0.5 microstrain

Signal Conditioner Option (-701)

For Ohms, RTD, ¼-bridge strain measurements.
Configuration: 3- or 4-wire, switch-selectable
Excitation Currents: 100 μA, 1 mA, 10 mA, switch-selectable
Accuracy: ±0.005% at calibration, 21°C to 25°C

Four-Wire Scanner Option (-115)

Capacity: Ten 4-wire channels (reed relays)
Life: >10^8 operations with <50V applied; >10^7 operations with <170V peak applied
Noise Rejection: Same as Option -109 except common mode rejection is 120 dB and normal mode rejection is 60 dB
Maximum Voltage: 170V dc or peak ac between any channel and any other channel and/or ground. 30V dc or rms ac between any two lines on the same channel
Connector Option: Use 2400A-116
Note: This scanner may not be used for voltage measurements.

Four-Wire Input Connector Option (-116)

Ten 4-wire sets of screw terminals for input wires enclosed in snap-apart plastic safety housing. Plugs into Scanner Module Option (-115)
Maximum Voltage: Same as for Option -115.

½- and Full-Bridge Strain Measurements

Total System Accuracy*

½-Bridge Mode: ±(0.015% of rdg + 4.5 microstrain) with both gages principally active
Full-Bridge Mode: ±(0.015% of rdg + 4.5 microstrain) with two gages principally active

Resolution: 0.5 microstrain

** For 90 days, 18°C to 28°C, 25 readings per second, 350Ω gage, 4V excitation*

Signal Conditioner Option (-702)
For ½- and full-bridge strain measurements
Excitation Voltage: 4,5,8,10,12,15, or 20V dc, software-selectable

Six-Wire Scanner Option (-117)
Capacity: Five 6-wire channels (reed relays)
Conductors: Excitation source (2); remote sense (2); analog input (2)
Life: $>10^8$ operations with <50V applied; $>10^7$ operations with <170V peak ac applied
Noise Rejection: Same as Option -109 except common mode rejection is 120 dB and normal mode rejection is 60 dB
Maximum Voltage: 170V dc or peak ac between any channel and any other channel and/or ground. 30V dc or rms ac between any two lines on the same channel.
Connector Option: Use 2400A-118

Six-Wire Input Connector Option (-118)
Five 6-wire sets of screw terminals for input wires enclosed in snap-apart safety housing. Plugs into six-wire scanner module Option -117

Other Input Specifications

Counter/Totalizer Signal Input Option (-113)
May be used to perform the following measurements: Frequency, period, totalize, tachometer, "A" gated by "B", and time interval.
Inputs: TTL, Gate 1, Gate 2, Trigger, Count Up, Count Down, Up/Down, Count, Non-Isolated Common, Isolated Common, Isolated Analog Input
Analog Input Voltage Range: 50 mV to 30V rms
Isolation: Both Analog Input and Isolated Common are isolated from the 2400B and/or ground up to 30V and up to 1.0 V/μs maximum slew rate
Frequency Range: 0 to 900 kHz (TTL Input); 10 Hz to 200 kHz (Analog Input)
Period Range
TTL Input: 1.1 μs to 6.7s
Analog Input: 5 μs to 0.1s
Period Resolution: 400 ns
Time Interval Range
TTL Input: 1 μs to 3.82 hr
Analog Input: 2 μs to 50 ms
Time Interval Resolution: 819 μs (≤3.82 hours); 400 ns (≤6.7 seconds)
Totalizer Input Range: Dc to 900 kHz
Minimum Pulse Width: 400 ns
Totalizer Capacity: -8,388,608 to +8,388,607
Connector: 12 screw terminals supplied with option

4 Channel Counter/Totalizer Option (-113/AA)
Measures period, frequency, time interval, and totalizes
Inputs: Four channels, non-isolated
Frequency Range: 0-500k Hz
Period Range: 10 μs to 50,000s
Totalizer Capacity: 4,999,999
Input Voltage Range: 175 mV to 70V rms
Connector: 12 screw terminals supplied with option

Digital Input Module Option (-103)
BCD Mode: 7 BCD digits +1 sign +3 decimal position bits
Binary Mode: 24 bits +1 sign bit
Logic Level: TTL, 0 to +0.75V low, +2.5 to +8V high
Rate: ≤250 words per second
Connector Options: Use 2400A-110 or 2400A-111

Status Input Module Option (-104)
Bits per Module: 32, isolatable from system ground or other modules by up to 30V dc or peak ac
Format: Individually readable
Input: Contact closures or TTL level
Connector Option: Use 2400A-110 or 2400A-111

Sequence of Events Recorder Option (-104/AA)
Number of Inputs: 32 channels
Channels Per System: 1024 max
Resolution: 0.1 ms to 100 ms, selectable

Interrupt Signal Input Option (-114)
Number of Inputs: 16, isolated in common from the 2400A and/or system ground up to 30V dc or peak ac and 1.0 V/μs maximum slew rate
Input Logic: Contact closures or TTL level, switch-selectable
Direct Input Sensitivity: Pulse duration >20 μs
Input Debounce: 5 ms to 88 ms, switch-selectable
Interrupt Transition: Software-selectable by input
Connector Option: Use 2400A-110 or 2400A-111

Screw Terminal Connector Option (-110)
Terminals: 50, for wire sizes up to #14 AWG

Solder Pin Cable Connector Option (-111)
Terminals: 50, for wire sizes up to #22 AWG

Control Output Specifications

Analog Control Output Option (-302)
Outputs: Isolated. Four per module. Voltage (-10V to +10V) or current (0 to 20 mA), individually selectable
Resolution: 2.5 mV (13 bits) or 5 μA (12 bits)
Isolation: ≤30V dc or peak ac, channel to channel
Max Load: ±5 mA in voltage mode; ≤750Ω in current mode
90-Day Accuracy: ±20 mV in voltage mode and ±20 μA in current mode for ambient temperature of 18°C to 28°C
Rate: 250 changes per second
Connector Option: Use 2400A-110 or 2400A-111

Status Output Control Option (-301)
Outputs: 32, open collector, diode clamped. 100 mA at ≤1.1 volt each. Common return line.
Isolation: ≤30V dc or peak ac, channel to channel or channel to ground
Rate: Set or reset at 250 bits per second
Connector Option: Use 2400A-110 or 2400A-111

Relay Output Card Option (-301/AA)
Number of Contacts: 16
Contact Rating: 250V ac at 3A with non-inductive load and 28V dc at 3A
Contact Arrangement: Form "C" (N.O. or N.C.)
Connector: Connector block integral to Option -301/AA (screw terminals)

Resistance Output Control Option (-305)
Outputs: Two
Isolation: ≤30V dc or peak ac channel to channel or channel to ground
Values: 0 to 4095Ω in 1Ω increments
Power Dissipation: 0.125W maximum
90-Day Accuracy: ±0.1% of full scale 18°C to 28°C ambient
Connector: Four screw terminals supplied with option

Resistance Output Control Option (-306)
Outputs: Two
Isolation: ≤30V dc or peak ac, channel to channel or channel to ground
Values: 0 to 102,375Ω in 25Ω increments
Power Dissipation: 0.125W maximum
90-Day Accuracy: ±0.1% of full scale 18°C to 28°C ambient
Connector: Four screw terminals supplied with option

Stepper Motor Control Output Option (-307)
Number of Outputs: One, non-isolated
Input Signals: External Enable, Closed-Loop Feedback
Input Logic: Contact closure or TTL level
Direct Output Signals: Four-Phase Unipolar Drive, Flyback Protected
Direct Output Current: 375 mA maximum
Logic Output Signals: CW/CCW direction and Step Clock, or CW and CCW Clock Outputs; Busy/Done
Output Logic: Open-collector TTL outputs. Interface to voltages up to 15V dc
Output Pulses: 1 to 1,048,575 CW or CCW
Slew Frequency: 1 Hz to 25.6 kHz, software-selectable
Acceleration and Deceleration Rates: 114 Hz/second to 97656 Hz/second. Software-selectable
Connector: 12 screw terminals, supplied with option

Note: Option -307 may be configured as a frequency source. Ask about Option -307/ABK

2400B Intelligent Computer Front End

General Specifications

Shock and Vibration: Meets MIL-T-28800C, Class 3 requirements
Temperature: 0°C to 50°C, operating; -20°C to +70°C, non-operating
Relative Humidity: ≤80% to 40°C and ≤70% to 50°C, operating, non-condensing
Power: 90 to 132V ac or 180 to 264V ac, switch-selectable, 50 or 60 Hz ±2 Hz, 130 watts maximum
Size: 22 cm H x 43 cm W x 38 cm D (8.66 in x 16.9 in x 14.96 in) for 2400B, 2401A, 2402A, and 2403A. Fit standard 19-inch rack

Weight
2400B: 11.4 kg (25 lb)
2401A: 6.4 kg (14 lb)
2402A: 11 kg (24 lb)
2403A: 8.2 kg (18 lb)
**Approximate, fully loaded*

Models

	January 1986 prices
2400B Intelligent Computer Front End	$4390
2401A Scanner Extender Chassis	1390
2402A I/O Extender Chassis	2260
2403A Remote A/D Extender	1710

Options

2400B-001 Serial Interface*	690
2400B-002 IEEE-488 Interface*	690
2400A-101 High Performance Scanner	450
2400A-102 Thermocouple & DC Voltage Input Connector	195
2400A-103 Digital Signal Input	440
2400A-104 Status Signal Input	530
2400A-104/AA Sequence of Events Recorder	on req.
2400A-106 Current Input Connector	225
2400A-108 DC Voltage Input Connector	135
2400A-109 High Performance A/D Converter**	1195
2400A-110 Screw Terminal I/O Connector	135
2400A-111 Solder Pin I/O Connector	45
2400A-113 Counter/Totalizer Signal Input	630
2400A-113/AA 4 Channel Counter/Totalizer	on req.
2400A-114 Interrupt-Signal Input	550
2400A-115 Four-Wire Scanner	485
2400A-116 Four-Wire Input Connector	135
2400A-117 Six-Wire Scanner	535
2400A-118 Six-Wire Input Connector	135
2400A-119 AC Voltage Input Connector	215
2400A-301 Status Output	510
2400A-301/AA Relay Output	on req.
2400A-302 Current/Voltage Analog Output	990
2400A-305 Resistance Output (1Ω to 4 kΩ)	660
2400A-306 Resistance Output (25Ω to 100 kΩ)	660
2400A-307 Stepper Motor Control Output	695
2401A-401 Scanner Extender Interface	155
2401A-402 Extender Cable (custom length)	25/m
2401A-403 Connectors for 2400A-402 Cable	205
2402A-501 I/O Extender Interface	310
2402A-502 I/O Cable (with connectors, 9m)	295
2403A-601 Remote A/D Extender Interface	270
2403A-602 A/D Extender Cable (custom length)	5m
2403A-603 Connectors for 2403A-601 Cable	70
2400A-701 Signal Conditioner for Ohms, RTD's ¼- & ½-Bridge Strain Measurements	530
2400A-702 Signal Conditioner for ½- and Full-Bridge Strain Measurements	635

**Option -001 or -002 is required*
***Required for analog measurements*

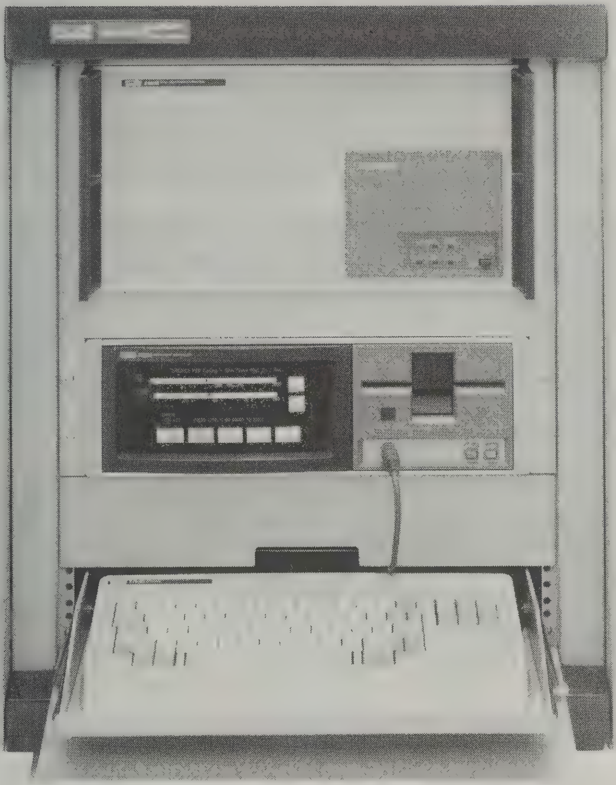
Accessories (Also see page 230)

1780A InfoTouch® Display	1995
Y1707 2m Cable for RS-232-C	125
Y1705 RS-232-C Null Modem Cable	75
Y8022 2m Cable for IEEE-488	95
Y2053 Rack Adapter w/24" slides	195
Y2054 19" Rack Adapter w/o slides	120
Y2055 RS-422 Multi-connector	95

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

2452MCS Measurement & Control System



2452MCS

2452MCS Measurement & Control System

- Complete system — combines 2400B Intelligent Computer Front End, 1752A Data Acquisition System, and software
- Extensive selection of I/O options — expandable to over 1000 channels with 2401A and 2402A extender chassis
- Touch sensitive screen — friendly operator interface with graphics
- "Multi-computing" — 2400B handles scanning, linearizations, limit checking and direct control of test or process. — 1752A downloads and modifies 2400B program, retrieves scanned data, formats and outputs reports, and provides operator interface
- Available with or without 28 inch cabinet
- Choice of IEEE-488 or Serial (RS-232-C, RS-422) Interfaces

The 2452MCS is a fully integrated measurement and control system which combines the power of two intelligent Fluke instruments — the 1752A Data Acquisition System and the 2400B Intelligent Computer Front End. The system is housed in a locking cabinet that fits on either a work bench or separate stand and includes all the hardware, cables, drawers, etc. necessary to combine the 2400B and 1752A into a complete measurement and control system. Alternatively, the 2452MCS may be ordered without a cabinet to be mounted in your own rack or panel.

The 2400B provides digital and analog measurement, signal conditioning, control outputs, and intelligent decision making, while the 1752A provides tremendous computing power, high speed data acquisition, a CRT display with a touch-sensitive overlay, advanced graphics capabilities, and mass storage via a double-sided floppy disk. Both instruments work together, sometimes independently, sometimes cooperatively, providing a multi-computing system with the power and flexibility to expand as your application requirements increase.

The programmer's keyboard is placed on a convenient sliding rack drawer that may be locked to prevent unauthorized program modification. The system can be programmed to allow the touch-sensitive CRT display to be the operator's interface. This reduces operator errors and training time because the operator interacts with a friendly CRT display customized for the application and written in familiar words.

The 2452MCS, when equipped with the 2400B's Serial interface, permits the 2400B to be located up to 1220 meters (4000 feet) away from the 1752A. A distributed data acquisition system may be constructed in this manner using a single 1722A or 1752A and multiple 2400Bs, in either star or "daisy chain" configurations.

The basic 2452MCS System includes the software tools, and hardware necessary to make it operate as a ten-channel data acquisition system. The system is expandable to sixty channels in the basic 2400B mainframe and to over 1000 channels by adding 2401A and/or 2402A Extender Chassis and input/output options.

Input/Output Capabilities

The measurement of analog inputs such as thermocouples, RTDs, strain gages, dc and ac voltages, and currents can be performed by a 17-bit A/D converter in the 2400B. Capable of resolving 1 μV, the highly accurate A/D conversion preserves data integrity through a sophisticated noise rejection technique that synchronizes its measurement period with the power line frequency. For high speed measurements, analog inputs can be brought directly in to an optional analog measurement processor in the 1752A for 14 bit resolution at 1000 readings per second.

Digital inputs accommodated by the 2452MCS include status, contact closure, interrupt, BCD, pulse, frequency, totalizing and sequence of events.

Controlling outputs sourced by the 2452MCS consist of voltage, 4-20 mA current, resistance, stepper motor control, TTL outputs, and relay closures. A complete description of input/output capabilities is found in the pages describing the 2400B.

Software supplied with the system includes a program development package ("ProLink II"), an enhanced BASIC interpreter with extended graphics capabilities, an advanced Editor, and a File Utility Program. The 2452MCS -03 and -04 also include the ProComm software package. (ProLink II and ProComm are both described in a section immediately following the 2452MCS description.) This complete package makes it easy for an individual with some knowledge of BASIC or other high-level programming language to create a custom-tailored data acquisition program to meet any application.

If you want to "come up to speed" and write your application program in a hurry, Fluke can help — with training classes held either at our head offices in Everett, Washington, U.S.A., or at your site. We can also arrange for one of our in-house experts to assist you personally in creating your application-solving software through a program called "Systems Lab."

If a turn-key system is what you require, Fluke has an extensive list of recommended software consultants that are experienced with Fluke equipment and capable of fulfilling your needs. The Fluke Customer Support Group is also available to write custom application software and combine with Fluke hardware for a complete system. Information on training classes, Systems Lab, software consultants, and the Customer Support Group is available from your Fluke Sales Engineer or Representative.

2452MCS Measurement & Control System

Specifications

For complete specifications please refer to the pages in this catalog describing the 1752A and the following pages that describe the 2400B.

CRT Display: High contrast green phosphor, high resolution, 5x9 inch display screen. Sixteen lines of eighty characters or eight lines of forty characters, selectable by program control.

Transparent Touch-Sensitive Overlay: Positioned directly over the display screen. Provides a 6x10 array of touch-sense areas for dynamic operator interface.

Graphics Display: 640 by 224 dots, hardware sector generator

Memory, 1752A: 136K bytes of RAM (expandable to over 2.6M bytes)

Memory, 2400B: 28K bytes of RAM for program storage

Mass Storage
- Double-sided 5¼-inch floppy disk stores 400K bytes
- 800K bytes more with dual floppy disk drive (optional)
- 10M bytes with Winchester Disk (optional)
- 1.3M-byte bubble memory (optional)

1752A Communications Interfaces: One IEEE-488 port and one RS-232-C port is standard. May be expanded to include six additional RS-232-C, RS-422, and/or 20 mA serial ports or a second IEEE-488 port

2400B Interfaces: Three. One IEEE-488 port or one serial (RS-232-C, RS-422, or 20 mA) port, and two RS-232-C output-only ports

Temperature: 10°C to 30°C, operating; -10°C to 60°C, non-operating (except floppy disks limited to 10°C to 52°C)

Relative Humidity: 5% to 80% operating, non-condensing; 5% to 95%, non-operating and non-condensing (except floppy disks limited to 8% to 90%)

Power: 90 to 132V ac or 180 to 264V ac, switch-selectable, 50 Hz to 60 Hz, ±2 Hz

Size: 70.6 cm H x 61.0 cm W x 70.5 cm D (27.8 in x 24 in x 27.8 in)

Weight: 84 kg (185 lb) approximately, not including options

Models

January 1986 prices

2452MCS-01	$13,450
2452MCS-02	12,990
2452MCS-03	13,450
2452MCS-04	12,990

Model and Version	Rack Cabinet 71 cm (28 in) High	2400B Interface and 2 Meter Cable
2452MCS-01	Yes	IEEE-488 (Opt -002)
2452MCS-02	No	IEEE-488 (Opt -002)
2452MCS-03	Yes	Serial (Opt -001)
2452MCS-04	No	Serial (Opt -001)

The rack cabinet has a lockable storage drawer and keyboard drawer, a rear door, and associated hardware.

Also included are:
- 1752A-1 with Keyboard
- Fluke enhanced BASIC Interpreter, Advanced Editor, File Utility Program
- ProLink II application software package (see page following for description)
- ProComm application software package (-03, -04 only) (see page following for description)
- 2400B with Option -101, -102, -109, and -002 (or -001)
- Integral power strip and power cord
- Full set of Operator and Service Manuals
- 90-day on-site service

Options

See 2400B and 1752A pages

Accessories (Also see page 230)

A24-89 71 cm Instrument Rack (28 in)	on req.
A24-75 183 cm Instrument Rack (6 ft)	on req.
A24-90 Wheeled based, for A24-89 or A24-75	on req.
A24-123 Serial Impact Printer w/RS-232-C I/F	on req.
Y2055 15-Pin Multi-Connector for Multi-Drop RS-422 Hook-up ("Y" Connector)	95
1765A/AB 10M-byte Winchester Disk Drive	4250
1761A External Disk Drive, 2x400K bytes	2950
1760A External Disk Drive, 400K bytes	1950

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

Measurement & Control Software

For the first time, Fluke offers a wide range of application software to help you develop your 2400B program.

Three of these software packages are designed to be used with the 2452MCS. They are Fluke ProLink II™ Application Software, ProComm™ Serial Communications Utility Package, and ProGen™ Application Software Package.

A fourth software development tool, ProLink PC,™ runs on your IBM PC,™* PC XT,™* or IBM compatible.

ProLink II Application Software

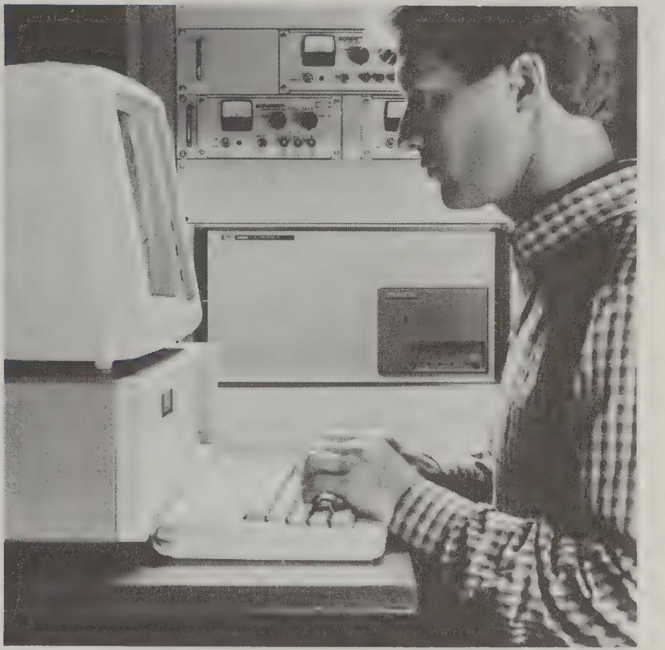
- For use with Fluke 1722A/1752A and 2400B — ProLink II is supplied with all 2452MCS Systems
- Simplifies development of 2400B application program
- Menu-driven user interface

Fluke ProLink II Application Software comes standard with all 2452MCS systems. It is a tool which makes developing 2452MCS application program easier.

The 2452MCS consists of two independent computers: the Fluke 2400B and the 1752A Data Acquisition System. These two computers must talk to each other in order to do the job. Fluke ProLink II handles a lot of the system housekeeping tasks you would otherwise have to do. It presents you with a single user interface to both the 1752A and 2400B.

ProLink II presents the user with a menu of choices. You simply move the cursor to the proper selection and press the carriage return. This "one-touch" approach lets you do the following:

1. Automatically run Fluke BASIC; FUP, the File Utility Program which allows you to copy, move, delete or otherwise manipulate files; and SET, which allows you to set the RS-232-C characteristics of the 1722A/1752A output ports. After exiting any of these three programs, you will automatically be returned to ProLink II.
2. Automatically send bus commands to the 2400B and display responses to those commands.
3. Automatically display English language error messages if an error occurs.
4. Select, edit, download or retrieve user written 2400B programs.
5. Monitor selected variables during program execution. This function is very useful during the program debugging stage. You can download and run your 2400B program, and then monitor certain key variables. In this way you can ensure that variables are changing as you expect them to.
6. Print a hard copy of a file on an external printer.



ProComm Serial Communications Utility Package

- For use with 1722A/1752A and 2400B equipped with 2400B-001 serial I/F — supplied standard with 2452MCS-03 and -04
- Implements serial communications between 1722A/1752A and 2400B, or multiple 2400Bs connected to single 1722A/1752A
- Provides built-in error detection and recovery capability
- Supports communications via modems as well as "hard-wired"

ProComm™ Serial Communications Utility Package comes standard with both serial versions of the 2452MCS, -03 and -04.

ProComm software is a utility package which implements serial communications between the 1722A/1752A and the 2400B Front End. The subroutines are callable from BASIC.

There are three functions which ProComm software can provide for you. If you are using an RS-422 or current loop transmission line, you can have more than one 2400B connected to your 1722A/1752A. This is called a multipoint system. ProComm software allows you to address and unaddress (terminate communications with) each 2400B in your system.

Second, ProComm software also implements the highest level message transfer protocol supported by the 2400B, blocked format with acknowledgements and check character. This message transmission protocol provides your communications link with built-in error detection and recovery capability. It is especially useful in electrically noisy applications, or where you must guarantee the integrity of your data.

Third, if you are using a 2400B with an autoanswer modem across an RS-232-C interface, ProComm software will automatically hang up the phone line on demand.

Measurement & Control Software

ProGen Application Software

- For use with 2452MCS Systems
- Menu-prompted monitoring/controlling/logging program
- Requires no language programming knowledge to operate
- Supports up to 500 channels of input/output

ProGen Application Software allows user to get up and running quickly with the 2452MCS. It is a menu-prompted tool which actually programs the 2452MCS for you. Your 2452MCS can be monitoring and controlling your process or test in a short time.

ProGen software is compatible with all versions of 2452MCS, serial or IEEE-488. A 17XXA-007 512K byte RAM expansion option must be installed.

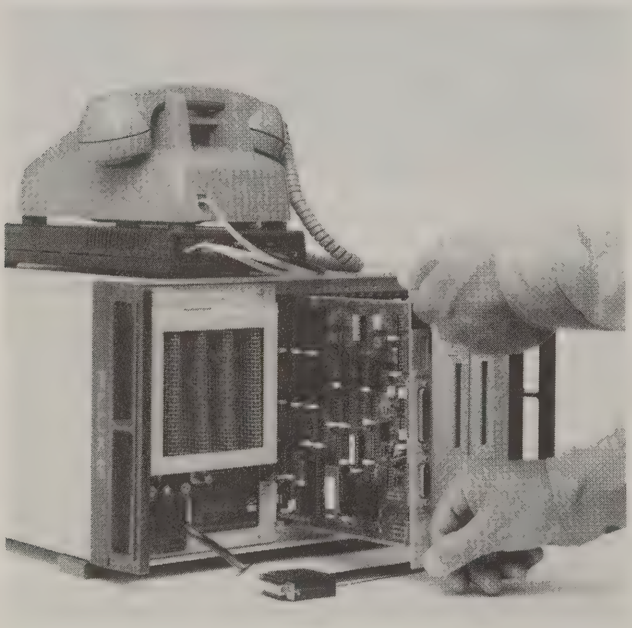
Fluke realizes that there may be one person who programs the application, and another who operates it. Accordingly, ProGen software has two separate disks: Programmer and Operator.

The person responsible for configuring the 2452MCS to meet the application uses the Programmer disk. This disk, in turn, creates the Operator disk.

The programmer is prompted to either "fill-in-the-blanks" or use the cursor control keys to move the cursor to the proper choice. Up to 500 channels can be monitored and controlled. In addition, you may select one of up to 100 user-defined limits lists of four limits each to apply to each channel.

The operator can change only those limits and setpoints which the programmer allows. The operator can, however, choose to monitor all data, some data, or alarms only. Alarm data is automatically recorded.

ProGen software is the easy way to get your 2452MCS up and running.



ProLink PC Application Software

- For use with IBM PC* and Fluke 2400B Intelligent Computer Front End (serial communication)
- Simplifies development of 2400B measurement and control program
- Menu-driven user interface

ProLink PC is a menu-driven tool for developing 2400B programs with an IBM PC,™ PC XT,™ or IBM compatible. Similar in scope and function to ProLink II software, ProLink PC software will handle the communications between the two computers.

Your IBM PC must have an optional serial interface installed. Since the PC XT has this interface standard, ProLink PC software will operate directly on the XT. MS-DOS™ version 2.1 or higher is required.

The operator interface operates similar to ProLink II. The user is presented with a menu of choices. These choices allow you to do the following:

1. Set the RS-232-C characteristics of the IBM communications ports.
2. Select, download, or retrieve user written 2400B programs.
3. Automatically send bus commands to the 2400B and display responses to those commands.
4. Automatically display English language error messages if an error occurs.
5. Monitor selected variables during program execution for program debugging.
6. Print a hard copy of a file on an external printer.
7. Exit ProLink PC to the IBM's operating system. The user can then use the editor EDLIN to edit his 2400B program.
8. Automatically set the date and time in the 2400B.

**IBM PC and IBM PC XT are trademarks of International Business Machines, Inc.*
**MS-DOS is a trademark of MicroSoft, Inc.*

Models

January 1986 prices

S2400	ProLink II Application Software	$ 795
S2401	ProLink PC Application Software	450
S2417	ProComm Serial Communications Package	295
S2452	ProGen Application Software	950

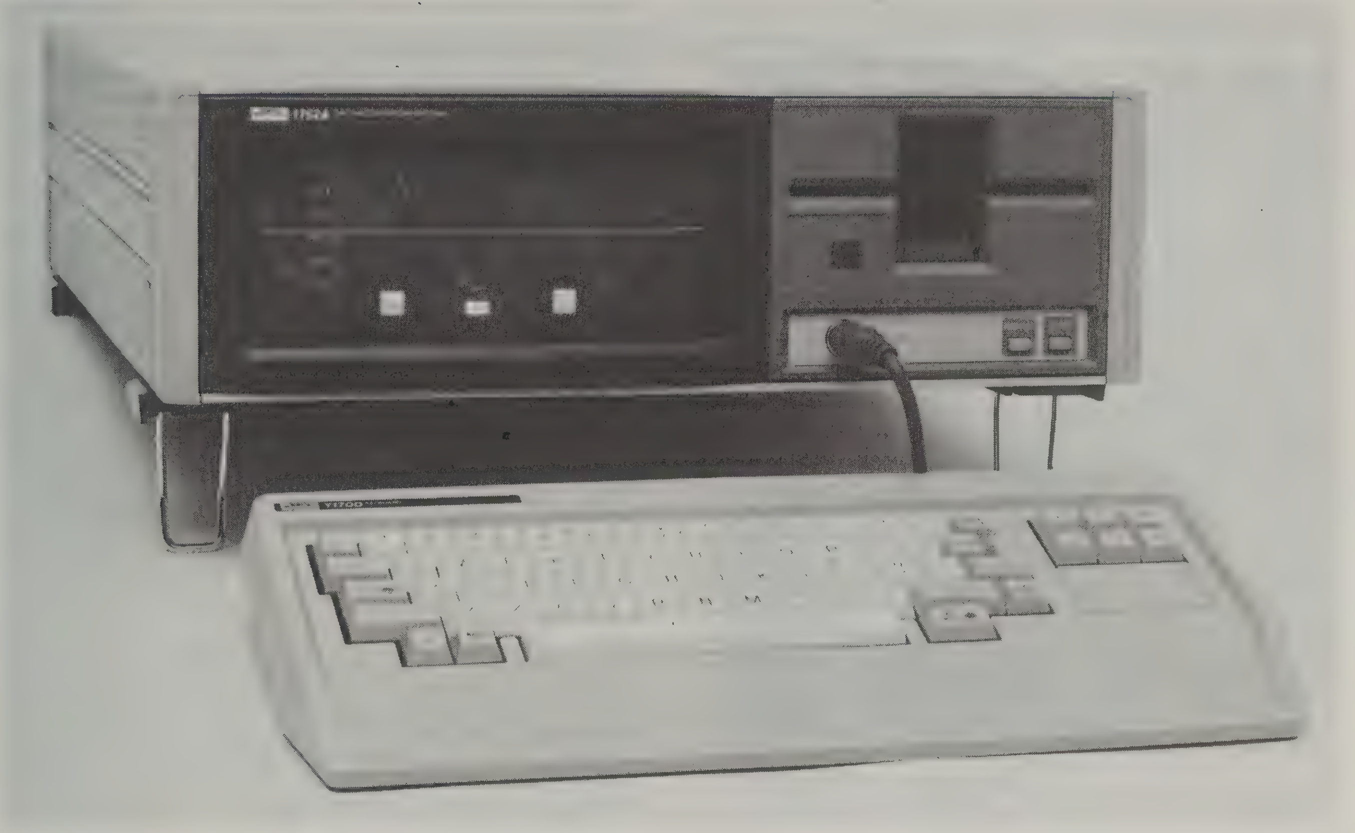
After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

DATA ACQUISITION SYSTEM

1752A

NEW



1752A With Keyboard

1752A Data Acquisition System

- Analog Measurements to 1,000 per second, accuracy of 0.02%
- Touch Sense Graphics Display
- High Performance Processor with Macrostore™ floating point processing
- 136K bytes RAM Expandable to 2.6M bytes
- 400K byte Floppy Disk
- BASIC Programmable with real-time and measurement and control extensions
- IEEE-488, RS-232/422, Current Loop and Parallel Interfaces
- Rack Mountable with removable keyboard
- Analog Control Option (Voltage or Current)
- Status Input/Output Option
- Counter/Totalizer Option

The Fluke 1752A Data Acquisition System is a powerful microcomputer-based system for measurement and control applications. The data acquisition functions are integrated into the same chassis as the computer to minimize desktop or rack space, simplify programming, and increase system performance. The 1752A's BASIC offerings provide a structured programming environment tailored for high speed data acquisition and instrument control. Single-word commands simplify the task of writing programs for both data acquisition and IEEE-488 compatible instrument control.

Its touch screen replaces a keyboard or switch panel, allowing the operator to respond to prompts one at a time. System control may then be accomplished by simply touching the screen.

High Performance Microcomputer

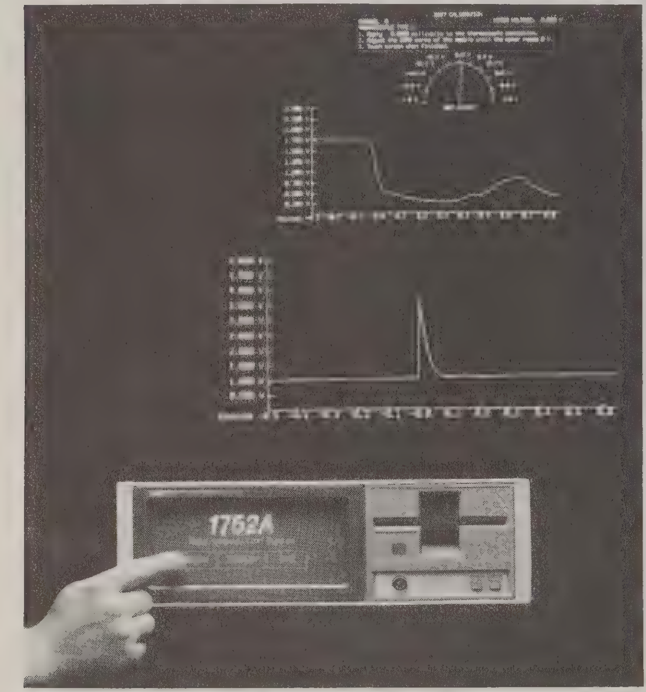
The 1752A is a microcomputer designed for control of automated instrument systems in the laboratory, the plant, or the factory and for information management systems.

The 1752A's high speed 16-bit microprocessor uses a 24 MHz clock to achieve an instruction cycle rate of 6 MHz. High-speed floating point arithmetic processing is implemented through extensions to the microprocessor instruction set. A separate display processor, with high speed vector generator and graphics memory workspace, functions as an independent graphics display terminal for the central processor.

When started up, the 1752A looks to its internal floppy disk (or to optional internal bubble memory) for operating software. Updating to newer software is a simple matter of inserting a disk and restarting. You are not tied to permanently-installed ROMs. Yet the 1752A is easily set up to automatically start running your application. After loading operating software, it looks for a start-up command file. The file is treated as keyboard inputs, instructing the controller to perform any task sequence. If software is stored in optional non-volatile bubble memory, you never need to bring a disk near it.

RAM memory in the 1752A can be partially allocated as a file-structured electronic disk, for high speed task overlays and large, fast-access virtual data arrays. Software development tools make the task of writing programs more efficient through such features as wildcard file identification, utility command files, and recall of previously typed commands.

The 1752A includes four slots for additional memory and interface options. The standard 136K RAM memory is internally expandable to over 2.6 megabytes. The 400K-byte internal floppy disk drive capacity can be expanded through the 1760A or 1761A Disk Drives to 2 megabytes of on-line floppy disk file storage. An external Winchester Disk Drive System brings 10 megabytes of file capacity on-line. And bubble memory options can be installed for up to 1.0 megabytes of rugged, non-volatile file storage especially well suited for harsh environments.



Touch-Sensitive Display System

Touch-Sensitive Display System

With its touch-sensitive display, the 1752A is particularly well suited for applications where semi-skilled personnel need to operate complex systems performing sophisticated tasks. The friendly graphics display takes the place of the often-intimidating keyboard, yet offers access to the software that keeps your system running. An operator is prompted one step at a time for information or decisions through informational displays, and responds by simply touching the screen. The predictability of procedures allows true trend analysis to be performed, pinpointing common failure modes or process impediments. Systems based on this concept are easily updated for new tasks. The cost and downtime of installing new switch or key labels is eliminated.

Fluke's experience producing the touch-sensitive display overlay goes back to 1979. It has proven to be a rugged, reliable component.

Characters Plus Graphics

The graphics display capability of the 1752A is independent of its character display, and of the 1752A central processor. With its own display processor, high speed vector generation hardware, and 64K graphics display memory, the 1752A is a sophisticated tool in the hands of the creative system designer. The 64K display workspace is over three times the size of the 640 by 224 pixel display window: 2048 pixels wide by 256 pixels high. You can use it to display data in strip chart form, and move the display across the window by touch commands. You can also use it to prepare up to three independent data screens available for instant display. Once the graphics display is generated, a hard copy of the graphics plane can be printed under program control.

The 1752A character display is an independent function that can overlay graphics data displays for labels, or be used alone for text and for programming. Because the graphics and character displays can be independently enabled, screens can be prepared "off-line" and displayed when ready. Numerous ANSI-compatible character attributes are available to add emphasis to portions of displays. Attributes such as inverse or underline can be pre-defined for display fields, or made a part of characters as they are sent to the screen.

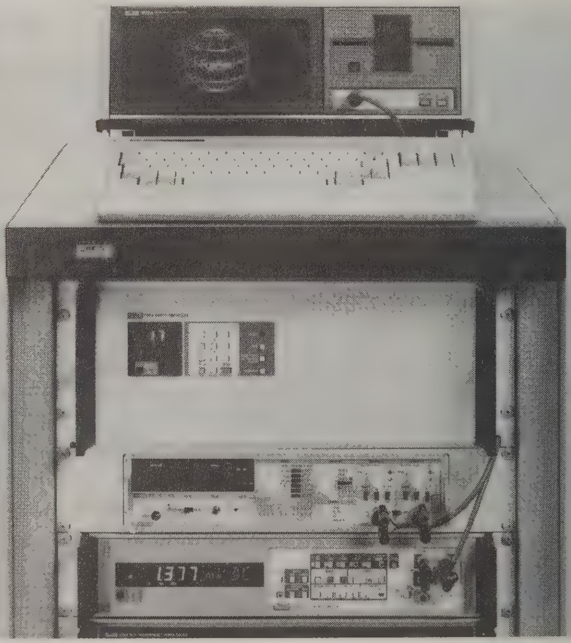
The 1752A includes an industry standard composite video output that will display whatever is on the 1752A screen on a video monitor. This can be useful for training presentations as well as for system requirements that include a remotely mounted display.

Data Acquisition and Control

The 1752A-010 Analog Measurement Processor allows the 1752A to connect to 16 differential or 32 single-ended inputs, and acquire data at up to 1,000 readings per second. Multiple 1752A-010's may be installed to increase system throughput to 4,000 readings per second. (Any single input, however, can be sampled at a maximum rate of 1,000 per second.) Normal mode rejection may be added through either internal line synchronization, or external synchronization, using the Y1752A Line Synchronization Transformer. The Analog Measurement Processor interfaces to the 1752A bus without isolation. Inputs are protected against damage to 50V dc, and fused input resistors decrease the risk of dangerous higher voltages reaching system operators. An external signal conditioning subsystem is available which provides isolation as well as signal conditioning for inputs such as ac voltages, thermocouples, RTDs and strain.

For analog control, use the 1752A-011. This option allows the 1752A to control devices which accept a 0 to 20 mA or a ±10V dc control signal. Each of the four outputs can be individually configured for either current or voltage.

For frequency, time, and totalizing measurements, the 1752A-012 option offers a single input. To sense switch closures or logic levels, as well as perform on-off control, use the 17XXA-002 Parallel Interface. This option offers 32 bits configurable for either input or output. To switch higher levels, an optional digital isolation subsystem is available. To expand your system, use the 1702A Extender Chassis. This increases the number of slots available for measurement and control options by 11. More 1702's may be added for larger systems.



Interfacing

The 1752A includes an IEEE-488 bus interface and an RS-232-C serial data port. The IEEE-488 interface can control up to 14 instruments at transfer rates of up to 30K bytes per second. Powerful IEEE-488 commands are supported as a part of each 1752A programming language. The 1752A can be set up to function as a system controller or as an addressable device in a multiple-controller system. In either configuration, the 1752A can pass control to another controller and take it back when offered. As system controller, the 1752A starts up as controller-in-charge and can use IFC (Interface Clear) to reset all bus devices.

Three of the five expansion slots are available for additional interfaces:

Option 17XXA-008 adds an IEEE-488 interface and an additional RS-232-C serial data port. The 1752A can accomodate up to two IEEE-488 ports.

Option 17XXA-009 is a reconfigurable, dual serial-data port with its own buffer memory. It is supplied configured for RS-232-C with full modem compatibility. Each port can be easily reconfigured for a 20 milliamp current loop, or for RS-422 balanced lines. Up to three -009s may be installed for a total system of seven serial ports.

Option 17XXA-002 (Parallel Interface) gives you two independent 16-bit parallel I/O ports that can function as independent lines, 8-bit bytes, or 16 or 32-bit words. Line protocol is available (but not required), and the sense of the data can be reconfigured to either High true or Low true. A maximum of three modules may be installed for a total of six 16-bit ports.

Options & Peripherals

RAM Expansion Modules (-006, -007)

The internal program and data space can be expanded to over 2.0M bytes with RAM expansion modules. These modules can be added in either 256K or 512K byte increments. Your software can easily assign part of the RAM memory to perform an “electronic disk” function. Once programs are downloaded from floppy-disk drive, the 1752A will run entirely out of the electronic disk.

Bubble Memory Options (-004, -005)

The -004 and -005 options are bubble memory boards that provide either 256K (-004) of 512K (-005) bytes of file storage. The transfer rate is 25K bytes per second.

Bubble memory is solid-state medium which is immune to pollution and vibration, making it ideal for harsh environments where floppy disk operation is not practical. Bubble memory is nonvolatile, so it does not require battery back-up to retain its file contents through a power loss. Since bubble memory has a much greater tolerance to temperature extremes than other media, the 1752A can operate from 0°C to 40°C when bubble memory is the primary file storage medium.

External Floppy Disk Drive Systems (1760A and 1761A)

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage. The 1760A and 1761A use double-density dual-head disk drives. The full on-line capacity is 400K bytes for the 1760A, and 800K bytes for the 1761A, including a file directory for each floppy disk. They interface to the 1752A via the IEEE-488 port. Both systems are rack mountable and easy to install and use. Transfer rate is 22K bytes per second. Up to two 1761As can be accommodated, for a total of 2M bytes of on-line floppy disk file space.

Winchester Disk Drive (1765A/AB)

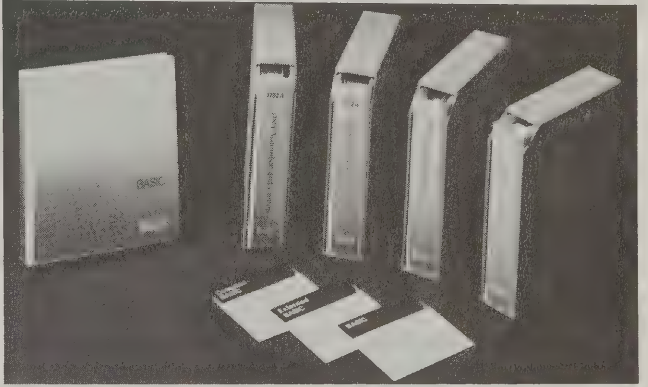
The 1765A/AB is a 5¼-inch Winchester Disk Drive that provides 10M bytes of mass file storage when used with the 1752A. It interfaces to the 1752A via the IEEE-488 port. Transfer rate is 22K bytes per second.

Software

The 1725A offers an environment specifically suited to the development of real-time control programs. For more information on 1752A software systems, consult the 1700 Series Software section, following this section. A data acquisition library provides routines directly accessible from BASIC, greatly simplifying data acquisition and control tasks. The “Getting Started” software provides the user with a number of useful programs, allowing the user to access many of the 1752A's capabilities through the touch screen.

Module-Level Diagnostics

The 1752A is a modular design with diagnostic software that allows semi-skilled operators to identify failures to the module level. Spare-module kits are available for the most time-critical applications. Fluke also maintains an inventory of 1752A modules that may be shipped within hours in most cases, and which can be exchanged for a defective module for a nominal charge. Contact your Fluke Technical Service Center for more information.



Manuals That Make the Task Easy

Experience will tell you that the major investment in an automated instrument system is not usually in the hardware, but in system integration and the development of application software to run it. The quality of documentation is a key consideration. You will find that 1752A manuals are among the most readable, consistent, and sensible software documentation available anywhere. Ask your Fluke Sales Engineer or Representative to let you evaluate the 1752A through its manuals. You will be pleasantly surprised.

Specifications

Analog Measurement Processor (-010)

Number of Channels: 16 differential or 32 single-ended (single and differential channels may be mixed)

System Capacity: 4 processors, 128 single-ended channels

Ranges: (full scale, each channel) ±1.0158V; ±10.158V; ±65 mA; 4 to 20 mA displayed as 0 to 100% of scale

Reading Rate: Synchronized Modes-400 channels/s @50 Hz, 480 channels/s @60 Hz, 400 channels/s @400 Hz; Asynchronous Mode-1000 channels/s

Accuracy (90 days): (10 to 40°C operating) 10V Range ±(0.02% of reading + 1.24 mV); 1V Range ±(0.02% of reading + 248 μV); 65 mA Range ±(0.05% of reading + 16.5 μA)

Common Mode Rejection: dc -77 dB; 50/60 Hz, 60 dB

Normal Mode Rejection: Asynchronous mode, 0 dB; internally synchronized, 20 dB; Externally synchronized, 45 dB

Input Protection: To 50V rms without side effects, fuse protected to 240V rms

Connector: Requires two Y1750s

Analog Control Output Option (-011)

Outputs: Isolated. Four per module. Voltage (-10V to +10V) or current (0 to 20 mA), individually selectable

Resolution: 2 mV (13 bits) or 5 μA (12 bits)

Isolation: ⩽30V dc or peak ac, channel to channel

Max Load: ±5 mA in voltage mode; ⩽750Ω in current mode

DATA ACQUISITION SYSTEM

1752A

90-Day Accuracy: ±20 mV in voltage mode and ±20 μA in current mode for ambient temperature of 18°C to 28°C
Rate: 1000 changes/sec
Connector Option: Use 2400A-110 or 2400A-111

Counter/Totalizer Signal Input Option (-012)

May be used to perform the following measurements: Frequency, period, totalize, tachometer, "A" gated by "B", and time interval.
Inputs: TTL, Gate 1, Gate 2, Trigger, Count Up, Count Down, Up/Down, Count, Non-Isolated Common, Isolated Common, Isolated Analog Input
Isolation: Both Analog Input and Isolated Common are isolated from the 1752A and/or ground up to 30V and up to 1.0 V/μs maximum slew rate
Frequency Range: 0 to 900 kHz (TTL Input); 10 Hz to 200 kHz (Analog Input)
Period Range
TTL Input: 1.1 μs to 6.7s
Analog Input: 5 μs to 0.1s
Period Resolution: 400 ns
Time Interval Range
TTL Input: 1 μs to 3.82 hr
Analog Input: 2 μs to 50 ms
Time Interval Resolution: 819 μs (⩽3.82 hours); 400 ns (⩽6.7 seconds)
Totalizer Input Range: Dc to 900 kHz
Minimum Pulse Width: 400 ns
Totalizer Capacity: -8,388,608 to +8,388,607
Connector: 12 conductors, supplied with option (screw terminals)

Parallel Interface (-002)

Data I/O lines terminated with 2400Ω to +5V, 5000Ω to ground, with diode input protection. Schematics provided with documentation. Update rate: 3000/s (status output).

General Specifications

Temperature: 10°C to 40°C with floppy disk, operating; 0°C to 40°C without floppy disk, operating. 10°C to 52°C with floppy disk, non-operating; -20°C to 60°C without floppy disk, non-operating
Relative Humidity: 20% to 80%, non-condensing, operating; 8% to 90% non-condensing, with floppy disk, non-operating or 5% to 95%, non-condensing, without floppy disk, non-operating
EMI and RFI Emissions: Tested to FCC Part 15, Subpart J, Class B; VDE 0871, Class B; CISPR 11-1975
Power: 90V to 132V ac or 180V to 264V ac, 47 Hz to 440 Hz. 175W maximum
Size: 13 cm H x 43 cm W x 55 cm L (5.25 in x 17 in x 21.5 in) plus feet
Weight: 14.5 kg (34 lb). Keyboard 1.4 kg (3 lb)
Included: Y1700 Keyboard, power cord, BASIC system disk, diagnostic disk, "Getting Started" manual and disk, System Guide manual, Operator's manual, BASIC Programming Manual, Data Acquisition and Control Guide, and a pad of 50 display worksheets

Model

	January 1986 prices
1752A Data Acquisition System (with one 1752A-010 Analog Measurement Processor)	$7400
1752A-1 Data Acquisition System (without 1752A-010 Analog Measurement Processor)	6500
1702A Extender Chassis (Requires 1752A-013)	2260

Options

17XXA-002 Parallel Interface	790
17XXA-004 256K byte Bubble Memory	3250
17XXA-005 512K byte Bubble Memory	5450
17XXA-006 256K byte RAM Expansion	1000
17XXA-007 512K byte RAM Expansion	1400
17XXA-008 IEEE-488/RS-232-C Interface	590
17XXA-009 Dual Serial Interface	850
1752A-010 Analog Measurement Processor	990
1752A-011 4 Channel Analog Output	990
1752A-012 Counter/Totalizer	630
1752A-013 Extender Interface	310

Software Options (Also see page 200)

17XXA-201 Assembly Language Software Development System	1495
17XXA-202 FORTRAN Software Development System	1495
17XXA-203 Compiled BASIC Software Development System	490
17XXA-205 Extended BASIC Development System	490

Peripherals

1760A Disk Drive System, 400K byte	1950
1761A Dual Disk Drive System, 800K byte	2950
1780A InfoTouch Display	1995
1765A/AB Winchester Disk Drive, 10M byte	4250

Accessories (Also see page 230)

Y1700 Programmer Keyboard	395
Y1703 RS-232-C Null Modem Cable, 4m	150
Y1705 RS-232-C Null Modem Cable, 0.3m	75
Y1706 Certified Blank Disks Unformatted (pkg of 10)	100
Y1707 RS-232-C Interface Cable, 2m	125
Y1708 RS-232-C Interface Cable, 10m	150
Y1709 Printer Cable, 2m	125
Y1711 Reinforced Shipping Case, w/handles	300
Y1717 Parallel Interface Cable	150
Y1750 Input Terminal Block with Cable	65
Y1751 Replacement Cable Set for Y1750	65
Y1752 Line Frequency Sync Transformer	50
Y1790 Rack Mount Kit with 24" Slides	175
Y1791 Rack Mount Kit for 1780A (requires slides)	95
Y1795 Portable Carry Handle	48
M00-260-610 18" Rack Slides	105
M00-280-610 24" Rack Slides	110
Y8021 Shielded IEEE-488 Interface Cable, 1m	85
Y8022 Shielded IEEE-488 Interface Cable, 2m	95
Y8023 Shielded IEEE-488 Interface Cable, 4m	105
2400A-110 Screw Terminal I/O Connector	135
2400A-111 Solder Pin I/O Connector	45

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

INSTRUMENT CONTROLLER

1722A

1722A With Keyboard

1722A Instrument Controller

- Microcomputer architecture designed for system control
- Touch display operator interface
- BASIC, FORTRAN, and Assembly programming language options
- Rack mountable with removable keyboard
- 136K RAM memory expandable to over 2.6 megabytes
- High resolution graphics with graphics print capability
- RS-232-C, IEEE-488, RS-422, or 20 milliampere current loop and bit parallel interfaces
- High speed floating point processing implemented in firmware
- Soft-loaded operating system

The 1722A represents the evolution of a concept pioneered and introduced by Fluke in 1980— the concept of using a touch-sensitive CRT display as the primary interface between an operator and a high-performance instrument controller. Few things could be more user-friendly. And it allowed the keyboard to be treated as a programming tool, usually unplugged and removed from an operating instrumentation system. Rack mounting was simple.

Fluke's first instrument controller was the 1720A. The 1722A has improved capabilities. But, because we are committed to maintaining the highest possible level of software compatibility consistent with evolutionary improvements, the 1722A runs programs that were developed for even the first 1720As delivered. As we continue to develop microcomputer products at Fluke, the software investments made by our customers remain a foremost design consideration.*

High Performance Microcomputer

The 1722A, is a microcomputer designed for control of automated instrument systems in the laboratory, the plant, or the factory and for information management systems.

The 1722A is an entirely new design internally. The high speed 16-bit microprocessor uses a 24 MHz clock to achieve an instruction cycle rate of 6 MHz. High-speed floating point arithmetic processing is implemented through extensions to the microprocessor instruction set. A separate display processor, with high speed vector generator and graphics memory workspace, functions as an independent graphics display terminal for the central processor.

When powered on, the 1722A looks to its internal floppy disk (or to optional internal bubble memory) for operating software. Updating to newer software is a simple matter of inserting a disk and restarting. You are not tied to permanently-installed ROMs. Yet the 1722A is easily set up to automatically start running your application. After loading operating software, it looks for a start-up command file. The file is treated as keyboard inputs, instructing the controller to perform any task sequence. If software is stored in optional non-volatile bubble memory, you never need to bring a disk near it.

RAM memory in the 1722A can be partially allocated as a file-structured electronic disk, for high speed task overlays and large, fast-access virtual data arrays. Software development tools make the task of writing programs more efficient through such features as wildcard file identification, utility command files, and recall of previously typed commands.

The 1722A includes five slots for additional memory and interface options. The standard 136K RAM memory is internally expandable to over 2.6 megabytes. The 400K-byte internal floppy disk drive capacity can be expanded through the 1760A or 1761 Disk Drives to 2 megabytes of on-line floppy disk file storage. The 1765A/AB Winchester Disk Drive System brings 10 megabytes of file capacity on-line. And bubble memory options can be installed for up to 1.3 megabytes of rugged, non-volatile file storage especially well suited for harsh environments.

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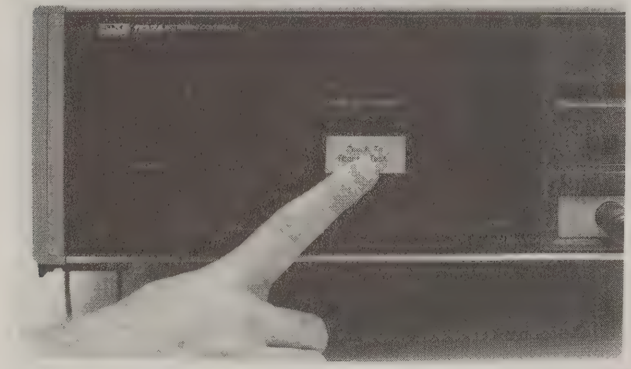
* *The 1720A and 1722A have been incorporated into a number of Fluke calibration systems. See pages 131 through 146.*

Touch-Sensitive Display System

With its touch-sensitive display, the 1722A is particularly well suited for applications where semi-skilled personnel need to operate complex systems performing sophisticated tasks. The friendly graphics display takes the place of the often-intimidating keyboard, yet offers access to the software that keeps your system running. An operator is prompted one step at a time for information or decisions through informational displays, and responds by simply touching the screen. The predictability of procedures allows true trend analysis to be performed, pinpointing common failure modes or process impediments. Systems based on this concept are easily updated for new tasks. The cost and downtime of installing new switch or key labels is eliminated.

Fluke's experience producing the touch-sensitive display overlay goes back to 1980. It has proven to be a rugged, reliable component.



Touch-sensitive interactive display

Characters Plus Graphics

The graphics display capability of the 1722A is independent of its character display, and of the 1722A central processor. With its own display processor, high speed vector generation hardware, and 64K graphics display memory, the 1722A is a sophisticated tool in the hands of the creative system designer. The 64K display workspace is over three times the size of the 640 by 224 pixel display window: 2048 pixels wide by 256 pixels high. You can use it to display data in strip chart form, and move the display across the window by touch commands. You can also use it to prepare up to three independent data screens available for instant display. Once the graphics display is generated, a hard copy of the graphics plane can be printed under program control.

The 1722A character display is an independent function that can overlay graphics data displays for labels, or be used alone for text and for programming. Because the graphics and character displays can be independently enabled, screens can be prepared "off-line" and displayed when ready. Numerous ANSI-compatible character attributes are available to add emphasis to portions of displays. Attributes such as inverse or underline can be pre-defined for display fields, or made a part of characters as they are sent to the screen.

The 1722A includes an industry standard composite video output that will display whatever is on the 1722A screen on a video monitor. This can be useful for training presentations as well as for system requirements that include a remotely mounted display.

Interfacing

The 1722A includes an IEEE-488 bus interface port and an RS-232-C serial port. The IEEE-488 interface can control up to 14 instruments at transfer rates of up to 30K bytes per second. Powerful IEEE-488 commands are supported as a part of each 1722A programming language. The 1722A can be set up to function as a system controller or as an addressable device in a multiple-controller system. In either configuration, the 1722A can pass control to another controller and take it back when offered. As system controller, the 1722A starts up as controller-in-charge and can use IFC (Interface Clear) to reset all bus devices.

Three of the five expansion slots are available for additional interfaces:

Option 17XXA-008 adds an additional IEEE-488 interface and an additional RS-232-C serial data port. The 1722A can accomodate up to two IEEE-488 ports.

Option 17XXA-009 is a reconfigurable, dual serial port with its own buffer memory. It is supplied configured for RS-232-C with full modem compatibility. Each port can be easily reconfigured for a 20 milliamp current loop, or for RS-422 balanced lines. Up to three -009s may be installed for a total system of seven serial ports.

Option 17XXA-002 (Parallel Interface) gives you two independent 16-bit parallel I/O ports that can function as independent lines, 8-bit bytes, or 16 or 32-bit words. Line protocol is available (but not required), and the sense of the data can be reconfigured to either High true or Low true. A maximum of three modules may be installed for a total of six 16-bit ports.

Options & Peripherals

RAM Expansion Modules (-006, -007)

The internal program and data space can be expanded to over 2.6M bytes with RAM expansion modules. These modules can be added in either 256K or 512K byte increments. Your software can easily assign part of the RAM memory to perform an "electronic disk" function. Once programs are downloaded from floppy-disk drive, the 1722A may run using only the electronic disk.

Bubble Memory Options (-004, -005)

The -004 and -005 options are bubble memory boards that provide either 256K (-004) of 512K (-005) bytes of file storage. The transfer rate is 25K bytes per second.

Bubble memory is solid-state medium which is immune to pollution and vibration, making it ideal for harsh environments where floppy disk operation is not practical. Bubble memory is nonvolatile, so it does not require battery back-up to retain its file contents through a power loss. Since bubble memory has a much greater tolerance to temperature extremes than other media, the 1722A can operate from 0°C to 40°C when bubble memory is the primary file storage medium.

External Floppy Disk Drive Systems (1760A and 1761A)

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage. The 1760A and 1761A use double-density dual-head disk drives. The full on-line capacity is 400K bytes for the 1760A, and 800K bytes for the 1761A, including a file directory for each floppy disk. They interface to the 1722A via the IEEE-488 port. Both systems are rack mountable and easy to install and use. Transfer rate is 22K bytes per second. Up to two 1761As can be accommodated, for a total of 2M bytes of on-line floppy disk file space.

Winchester Disk Drive (1765A/AB)

The 1765A/AB is a 5¼-inch Winchester Disk Drive that provides 10M bytes of mass file storage when used with the 1722A. It interfaces to the 1722A via the IEEE-488 port. Transfer rate is 22K bytes per second.

Software

For information regarding 1722A Software, see the following "Software" section.

Module-Level Diagnostics

The 1722A is a modular design with diagnostic software that allows semi-skilled operators to identify failures to the module level. Spare-module kits are available for the most time-critical applications. Fluke also maintains an inventory of 1722A modules that may be shipped within hours in most cases, and which can be exchanged for a defective module for a nominal charge. Contact your Fluke Technical Service Center for more information.

Manuals That Make the Task Easy

Experience will tell you that the major investment in an automated instrument system is not in the hardware, but in system integration and the development of application software to run it. The quality of documentation is a key consideration. You will find that 1722A manuals are among the most readable, consistent, and sensible software documentation available anywhere. Ask your Fluke Sales Engineer or Representative to let you evaluate the 1722A through its manuals. You will be pleasantly surprised.

OEM Sales — 1722A in Your Products

The 1722A is used as a component part of many products manufactured by companies other than Fluke. Custom packaging and matching paint colors are routinely negotiated. Fluke offers the discounts, policies, and worldwide support to make it work, too. If you are designing a product that would be more competitive with a touch-sensitive graphics display and a high performance microcomputer system, call your Fluke Sales Engineer or Representative for more information.

Specifications

Temperature: 10°C to 40°C with floppy disk, operating; 0°C to 40°C without floppy disk, operating. 10°C to 52°C with floppy disk, non-operating; -20°C to 60°C without floppy disk, non-operating
Relative Humidity: 20% to 80%, non-condensing, operating; 8% to 90% non-condensing, with floppy disk, non-operating or 5% to 95%, non-condensing, without floppy disk, non-operating
EMI and RFI Emissions: Tested to FCC Part 15, Subpart J, Class B; VDE 0871, Class B; CISPR 11-1975
Power: 90V to 132V ac or 180V to 264V ac, 47 Hz to 440 Hz. 175W maximum
Size: 13 cm H x 43 cm W x 55 cm L (5.25 in x 17 in x 21.5 in) plus feet
Weight: 14.5 kg (34 lb). Keyboard 1.4 kg (3 lb)
Included: Y1700 Keyboard, power cord, BASIC system disk, diagnostic disk, "Getting Started" manual and disk, System Guide manual, Operator's manual, BASIC Programming Manual, and a pad of 50 display worksheets

Model

January 1986 prices

1722A Instrument Controller	$6400
1722A-1 Instrument Controller w/o Keyboard	6200

Options*

17XXA-002 Dual 16 Bit Parallel Interface	790
17XXA-004 256K Bubble Memory	3250
17XXA-005 512K Bubble Memory	5450
17XXA-006 256K-Byte RAM Expansion	1000
17XXA-007 512K-Byte RAM Expansion	1400
17XXA-008 IEEE-488/RS-232 Interface	590
17XXA-009 Dual Serial Interface	850
17XXA-201 Assembley Language Software Development System	1495
17XXA-202 FORTRAN Software Development System	1495
17XXA-203 Compiled BASIC Software Development System	490
17XXA-205 Extended BASIC Software Development System	490

**All options are customer installable*

Peripherals

1760A 400K Byte Disk Drive	1950
1761A 800K Byte Dual Disk Drive	2950
1765A/AB 10M Byte Winchester Disk	4250
1780A InfoTouch® Display	1995

Accessories (Also see page 230)

Y1700 Programmer's Keyboard	395
Y1702 2m RS-232-C Null Modem Cable	125
Y1703 4m RS-232-C Null Modem Cable	150
Y1704 Circuit Board Extender	200
Y1705 0.3m RS-232-C Null Modem Cable	75
Y1706 Double-Sided Blank Disks (package of 10)	100
Y1707 2m RS-232-C Interface Cable	125
Y1708 10m RS-232-C Interface Cable	150
Y1709 2m Printer Cable	125
Y1711 Shipping Case	300
Y1790 Rack Mount Kit with 24" Slides	175
Y1795 Carrying Handle for portability	48
Y8021 1m Interface Cable for IEEE-488 bus	85
Y8022 2m Interface Cable for IEEE-488 bus	95
Y8023 4m Interface Cable for IEEE-488 bus	105

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

1700 SERIES SOFTWARE

1700 Series Software

The power of any computer system lies in the software that is supported with the system. The 1722A Instrument Controller and 1752A Data Acquisition System support a variety of software development systems, utilities and applications packages. Each package is designed to help the programmer develop software to fit the system to his particular application. Fluke also offers training and consulting services to help get your system up and running in the shortest possible time.

System Software

Fluke's FDOS operating system combines the best features of both benchtop computers and minicomputers. Like a benchtop unit, the user can power-up the system and immediately begin programming in BASIC. No further knowledge of the operating system is required. For the advanced programmer, powerful utilities allow the user to perform complex functions with a minimum of keystrokes. Features include:

File Utility Program — Simplifies management of file structured devices such as the floppy disk, or bubble memory. Its concise, simple commands allow the user to transfer the contents of files or whole disks with a single command. Other features include wildcards, interactive commands, and file protection.

SET — Allows software set-up of serial port communications parameters, including baud rate, timeouts, and XON/XOFF handshaking.

Alias File — Allows the user to define his own commands for the system.

Command Files — Allows the user to define command sequences for the system. Flexible features allow the user to develop interactive sequences which can interface with the operator through either the keyboard or the touchscreen. Command files may also be used to automate the controller's start-up sequence.

TCOPY — The touch copy utility allows the user to perform file management through the touchscreen. It allows copying of files by name, date of creation, etc.

EDIT — The system editor is a powerful screen editor, with capabilities for searching, replacing, and cut-and-paste.

SHELL — The user may set the default console program with the SET SHELL command. This allows the programmer to design a system where his application program is the only software that the operator can see.

Other utilities allow the user to configure the operating system, check compatibility between various versions of software, and set the time and date through the touchscreen.

BASIC

The 1700 Series supports three BASIC packages. Compiled BASIC and Extended BASIC are available as options. Each package provides the programmer with the development tools necessary to take on the task of developing industrial control systems.

Compiled BASIC

The 17XXA-203 Compiled BASIC Option provides greater flexibility and speed while maintaining the ability to compile Fluke Interpreted BASIC. Programs can be run three to five times faster with Compiled BASIC than with Fluke Interpreted BASIC, while using less memory. Compiled BASIC includes the capability of linking subroutines in FORTRAN or Assembly Language.

Compiled BASIC permits large multiple-line statements, and long descriptive variable names. It also permits labels to be used in place of line numbers for branch targets while leaving the use of line numbers optional. Compiled BASIC subroutines exchange parameters, and use local variables and common variables for true modularity. This freedom of format allows BASIC programs to be written in a readable, structured form. Multiple-line statements can be especially useful, for example, when a program requires many lines following an IF statement. Key features include:

- Program execution 3 to 5 times faster
- True subroutines with local variables
- Use of program overlays for large programs
- Three dimensional arrays
- Alphanumeric labels for lines and/or statements
- Long variable names
- Continuation lines — up to 200 lines per line number
- Powerful screen editor

Extended BASIC

The 17XXA-205 Extended BASIC Option provides a compiler that allows the 1722A programmer to easily develop large BASIC programs without having to use a complex overlay structure that can be required when using Fluke Compiled BASIC. (Program space can be over two megabytes.) The statements and syntax are the same as those found in our Compiled BASIC. Key features include all those mentioned for Compiled BASIC except execution speed is only twice as fast as Fluke Interpreted BASIC, while eliminating complex program overlays.

Comparison of Fluke BASIC Offerings

Feature	Interpreted BASIC	Compiled BASIC	Extended BASIC
Program Size	28K bytes	35K bytes	>2M bytes
Execution Speed Ratio (approximate)	1	3-5	2
Program Expansion Method	Chaining	Overlays	None required
Immediate Mode Commands	Yes	No	No
3-D Arrays	No	Yes	Yes
Continuation Lines	No	Yes	Yes
Long Variable/ Statement Names	No	Yes	Yes
True Subroutines	No	Yes	Yes
Program Libraries	No	Yes	Yes
Option To Omit Numbers	No	Yes	Yes
Input Line Statement Capacity	80	510	510
Import/Export Statements (Global Variables)	No	No	Yes
Step Mode Debugging	Yes	No	No

FORTRAN

The Fluke 17XXA-202 offers a complete system for development of FORTRAN programs or subroutines with performance rivaling many minicomputers. Fluke FORTRAN makes it easy to use the features of the 1700 Series. Libraries provide routines for numeric and text manipulation, touchscreen and graphics support, and communications, including IEEE-488. Fluke FORTRAN can also interact with the operating system to provide functions such as file management and interaction with the system's command line interpreter.

Typical Statement Execution Times

	BASIC	Compiled BASIC	FORTRAN
Math Functions Execution Time, msec*			
= (Assignment)	0.460	0.152	0.004
+	0.474	0.353	0.237
—	0.477	0.353	0.224
*	0.506	0.383	0.209
/	0.682	0.554	0.221
^	4.821	4.652	2.902
SIN	2.301	2.052	1.332
COS	2.431	2.202	1.242
TAN	4.771	4.512	2.802
ATN	3.361	3.122	1.422
SQR	1.611	1.382	0.842
LOG	2.351	2.112	1.462
LN	2.461	2.222	1.542
EXP	2.411	2.172	1.512
Control Statements			
FOR Loop (integer counter)	0.189	0.076	0.004
IF-THEN	0.622	0.121	0.110
GOSUB/RETURN	0.254	0.142	0.036

**Data may vary depending on application*

Assembler

The 17XXA-201 allows the programmer to develop high speed or specialized routines in assembly language. The package includes a structured preprocessor which allows the use of high level constructs for program flow control. Using Macrostore™, double- and single-precision floating point arithmetic instructions become part of the language, simplifying code development. Also provided is the Hex Debugging Tool (HDT), with disassembly capability to speed program development.

C

The 1722A C Development system features a modified implementation of Whitesmiths™ C. This complete implementation of C supports features such as user defined data structures, full compliment of math functions, bit fields, and string manipulation routines. For real-time and instrument control applications, the system supports a full complement of interrupt processing structures, IEEE-488 I/O commands, and a complete interface to the FDOS operating system. This package requires the purchase of the 17XXA-201 Assembly Language Development System. Contact your local Fluke representative for more information.

FlexSys Test Software (ATLAS)

To speed development and reduce software maintenance costs of test systems, the ATLAS language is available for the 1722. More information is available in the following FlexSys section.

Linkers and Library Management

Linking and Library Management utilities are provided standard with the following software packages:

- 17XXA-201 Assembly Language Development System
- 17XXA-202 FORTRAN Development System
- 17XXA-203 Compiled BASIC Development System
- 17XXA-205 Extended BASIC Development System

Fluke's Linking programs allow the user to modularize his program, by compiling routines one at a time, and then linking the final software package. This simplifies the management of projects requiring multiple software engineers. Support for overlays is offered through the Linkage Editor. The Library Manager may be used to build libraries of user defined routines.

Gabby

The GABBY Terminal Emulation Program (17XXA-901) is a communications program which provides a simple method of transferring files to and from almost any host computer. GABBY emulates a terminal attached to the host computer and also allows uploading and downloading of files between the 1700 Series and the host computer. With GABBY, all commands are accessed through the touchscreen, relieving the user from the task of learning cryptic command sequences.

Touchscreen Toolbox

Fluke's expertise in developing human interfaces using the touchscreen is made available to the programmer through the 17XXA-902 Touchscreen Toolbox package. The package cuts the time required to develop a menu based system, while ensuring that the resulting menus will be simple for the operator to use. The package also includes calculator-style and alphanumeric keypads to simplify the tasks of entering data such as process control parameters, operator identification, or serial numbers.

MBASIC (available early 1986)

MenuBASIC (MBASIC) is a tool designed to simplify the task of developing programs for Fluke Controllers. It provides access to a powerful BASIC language, complete with advanced structures such as CASE statements and true subroutines, and features designed to simplify systems development such as full IEEE-488 support and multi-level interrupt structure. MBASIC also features a powerful editor which can search, search and replace, and merge programs interactively.

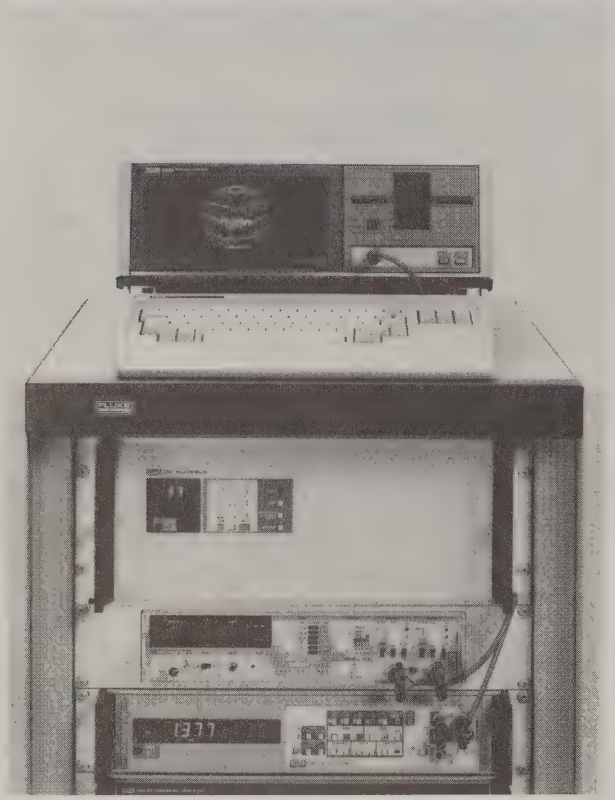
MBASIC makes these and other features easy to use by allowing the programmer to select actions from a menu presented on the screen. It is not required that the programmer memorize the commands, since they are displayed on the screen as part of the menu. This makes learning how to use MBASIC a simple task, as well as allowing single key commands to perform functions which require long command strings on most systems.

MBASIC features include:

- **BASIC Language:**
  Full IEEE-488 Support
  Multiple-Level Interrupt Structure
  Virtual arrays
  Line Numbers Optional
  True Subroutines with local variables
  Long Variable Names
  Advanced Control Structures (IF-THEN, WHILE, CASE, etc.)
- **Program Development:**
  Interactive Environment
  Advanced Editor with Search/Replace/Cut and Paste
  Interactive File Merging
  Simplified, Single Key Commands
- **System:**
  Ability to link other MBASIC, FORTRAN or Assembly Modules
  Full File Control (Copy, Delete, etc.)
  Complete Serial Port Control (Baud Rate, Parity, etc.)

ATLAS

NEW



FlexSys ATE Workstation Software (For 1722A)

- Allows reconfiguration without recompiling or modifying test programs
- Provides the advantages of ATLAS language at a fraction of the cost of current solutions
- Touch-sensitive, menu-driven user interface means easy training and use
- Compact workstation fits on bench or in the rack; expandable to 2.6 mbytes RAM
- Includes programming tools such as syntex checking, utilities for efficient debugging, and easily customized screen menus
- Integrates a wide range of ATE equipment via IEEE-488
- High-speed compile — typical 500 ATLAS statements per minute

FlexSys is a complete ATLAS software package that runs on Fluke's powerful IEEE-488 controller, the 1722A. For both large and small systems application, it provides the benefits of the ATLAS language at a fraction of the cost of other systems. FlexSys was developed by Fluke in conjunction with Lexico, a leader in ATLAS language systems.

With FlexSys, reconfiguration is rapid and easy without recompiling or modifying test procedures or Test Program Sets through the use of Resource Descriptions (RD). The result is lower cost for software development.

The Resource Description, the heart of FlexSys is a data base of instrument characteristics utilized by the system at run time. RD's define the codes and formats for a given instrument as well as the accuracies, ranges, timeouts and delays. The use of RD's at run time facilitates the rapid and straightforward configuration of the ATE station as well as independent of test program development from specific ATE hardware design.

FlexSys provides for:

- ATLAS Test Program Sets (TPS) development
- Resource Description generation
- Test station instrument configuration
- Compiled program execution in a real-time or simulated mode of operation

Test Program Set Development

A touch-screen, menu-driven interface lets the user develop Test Program Sets and retain a history of inputs easily and efficiently.

A parsing editor provides both manual and automatic syntax checking during development of ATLAS Test Program Sets.

The ATLAS Compiler prepares ATLAS test procedures for execution through four phases.

1. Verification of ATLAS syntax, semantics.
2. Generation of executable binary files.
3. Covering or comparing signal statement requirements to corresponding require statements to verify that the defined virtual resources can meet test program requirements.
4. Cross-reference table listing the connections between instrument ports and Unit Under Test (UUT) pins.

The Non-ATLAS procedure capability is used for the following:

1. Access to 20 predefined IEEE-488 bus drivers. The bus drivers allow direct control of 13 lines of the bus — the eight data lines and five control lines. The most common use of these drivers would be to manipulate a UUT which is controlled through the 488 interface. The drivers may also be used to control ATE functions not currently supported by IEEE ATLAS.
2. Perform user defined procedures displaying custom screen menus through a library of Touch Screen drivers. Utilization of Touch Screen menus allows full operator interaction with a running ATLAS TPS without the need for a keyboard.
3. Perform user defined procedures that utilize the pixel graphics capability of the 1722A.

The user can create Non-ATLAS Procedures in FORTRAN, C, or Assembly languages. (Support for procedures written in C available May 1986.)

Resource Description Development

With FlexSys actual resources used at run time need not be predefined — a feature unique among ATE Systems. Instead, Real Resources (Station Test Equipment) which meet the conditions of ATLAS REQUIRE statements are specified after compilation of the ATLAS test procedures. Information contained in the Resource Description Data Base specifies the following:

- Available functions and capabilities.
- Native IEEE-488 bus codes that control the instrument.
- The data format of information returned to the controller.
- Miscellaneous information such as settling times, instrument error codes, etc.

This data is used at run time, allowing compilation to be accomplished independent of real resources. RDs for system resources may be written by the resource manufacturer or by the user.

System Configuration

Independent System Configuration gives the user the ability to configure and reconfigure his system with minimal cost and effort by allowing the test program sets to be run without modification. Configuration integrates the instruments on the 488 bus into a functional ATE test station.

The configuration process identifies the instruments connected to the bus and creates a Resource Description Table. This table is a collection of resource descriptions, for each instrument in the test station taken from the RD library. ATE configuration is independent of the ATLAS Test Program Set so that the ATE configuration need not be re-established as long as the instruments on the bus do not change.

Resource assignment establishes the lògical mapping of the real resources on the bus to the virtual resources specified by the ATLAS Test Program Set to perform the following:

- Assign a real instrument resource for each virtual resource in the Test Program Set.
- Check that the real resources on the bus do, in fact, satisfy the virtual resource specifications in the ATLAS REQUIRE statements.
- Choose signal paths which are defined in the system interface RD for use at run time.

Test Execution

Test Execution provides for:

- TPS Selection
- Simulation
- Execution
- Debug Monitoring

TPS Selection

TPS Selection allows the test operator to select from available test programs. This is conveniently done using the touch-sensitive screen to page through possible selections and designate which test program to execute.

Simulation

The Simulation Option is provided to allow a test programmer to verify correct operation of test procedures and Resource Descriptions without actual use of the ATE system.

Test Execution

The test equipment is controlled using the programming codes extracted from a resource description to meet functionality specified in the ATLAS Signal Statement.

Debug Monitor

The debug monitor commands include single step execution, setting break points, enable program trace and examination of program variables. The test engineer may examine and alter system flags and the command buffers sent to the instruments. The debug monitor allows debugging to take place at the ATLAS statement level.

Documentation

Documentation is presented for both the novice and advanced users. Product documentation includes:

- Getting Started Manual
- System Guide
- System Configuration Manual
- ATLAS Program Development Manual
- Resource Description Development Manual
- Test Execution Manual

The FlexSys manual set is organized in reference form, with tab dividers, indexes, section headers on each page, and a consistent readable format. The manuals are supplemented with tutorial introductions and numerous examples.

The ATLAS ATE Workstation is available in three configurations:

Model 1790A-500

ATE system Development Software: Provides all capabilities required for resource description development, station configuration, TPS development and test execution, complete with sample RDs.

Model 1790A-400

TPS Development Software: Provides the capabilities required for TPS development configuration and execution (for the user who does not develop his own RDs).

Model 1790A-300

Test Execution Software: Provides all capabilities required for execution of ATLAS TPS.

Options

1790A-401 and 1790A-501 Simulation (available only for 1790A-400 and -500)
This option allows a test programmer to verify correct operations of test procedures without the actual use of an ATE System.

1790A-402 and 1790A-502 External Non-ATLAS Procedure Linkage (available only as an option for 1790A-400 and -500)
This option allows access to the 20 predefined IEEE-488 bus drivers and user defined procedures written in FORTRAN, C*, or Assembly languages. FORTRAN, package needs to be purchased as separate item 17XXA-202. "C" capability via External Non-ATLAS Module — the "C" compiler from Van Data and the Assembler package from Fluke (17XXA-201) has to be purchases separately.

1790A-301 Configuration (available only as an option for 1790A-300) (Included in -500 and -400)
This option allows for the rapid reconfiguration of hardware within the test station without recompilation of ATLAS Test procedures.

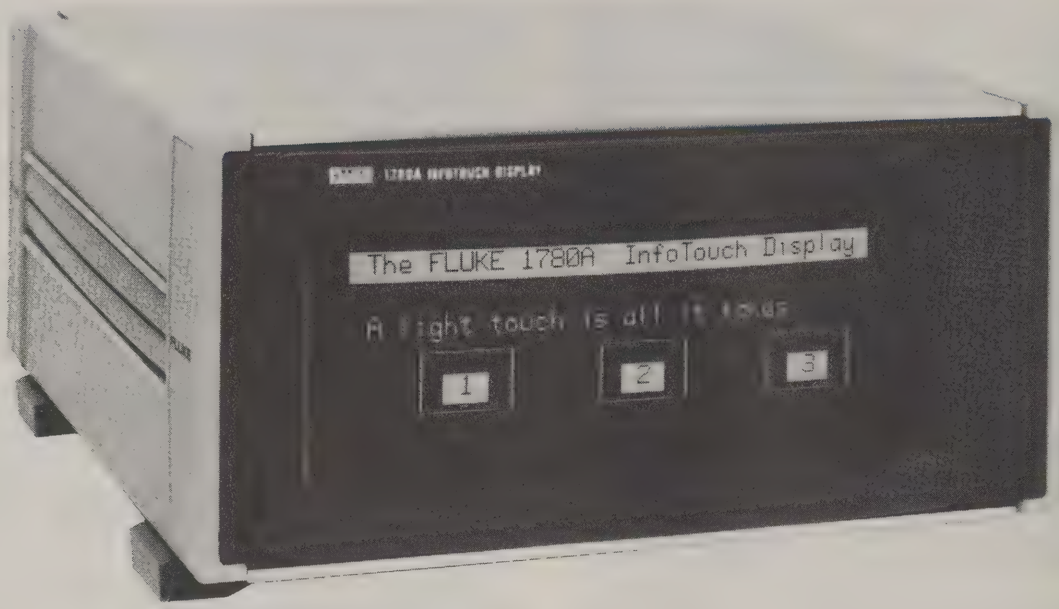
**"C" linker will be available after April 1986.*

Model

	January 1986 prices
1790A-500 Development System Software	$12,000
1790A-501 Simulation	750
1790A-502 Non-ATLAS Module Linkage	250
1790A-504 Phone-in Consulting Service for Development System Software, per month	100
1790A-400 Integration System Software	9950
1790A-401 Simulation	750
1790A-402 Non-ATLAS Module Linkage	250
1790A-404 Phone-in Consulting Service for Integration System Software, per month	100
1790A-300 Test Execution Software	3500
1790A-301 Configuration	250
1790A-304 Phone-in Consulting Service for Test Execution Software, per month	100

INFOTOUCH® DISPLAY

1780A


1780A INFOTOUCH DISPLAY
The FLUKE 1780A InfoTouch Display
A light touch is all it takes
1
2
3

1780A

1780A InfoTouch Display

- Flexible operator interface to computer-based systems
- Operates with any computer via RS-232-C interface
- 60 fingertip-sized touch sensitive areas
- Crisp, alphanumeric and character graphic display
- Compact, rugged packaging

The 1780A provides a simple yet sophisticated means of interfacing an operator to a complex control process.

Whether the operator is highly skilled in a particular manufacturing or test process, or is a first-time or occasional user of an on-line information system, the 1780A is the ideal link between the user and the computer at the heart of your system. The 1780A's display screen is used to present choices to the operator, and the transparent, touch-sensitive switch matrix overlaying the display receives the operator's response to those choices. Complicated processes can be performed in a series of steps, each involving a small number of choices.

The InfoTouch Display eliminates the complexity of remembering and correctly entering system commands at a conventional keyboard. Information presented to the operator at any particular time is under program control, allowing the system to guide the operator through the correct sequence of operations. And since the operator can only act upon the choices presented to him on the display, the possibilities of error are greatly reduced. Information can be presented to the operator in numbers, letters, graphic messages, or custom symbols or alphabets. The touch-sensitive overlay covers most of the screen, and provides 60 fingertip sized touch areas.

In the simplest implementation, the InfoTouch Display's integration of a display and touch sensitive overlay can be used to provide a more natural alternative to conventional function keys. Use of graphics characters and the flexibility afforded by the InfoTouch Display allows replacement of analog or digital readouts, toggle switches, rotary controls, pushbuttons, and annunciators. Application of the InfoTouch Display to a wide variety of information and equipment control processes is limited only by your imagination.

Customizing the InfoTouch Display panel is a simple programming task of writing and storing sequences of ASCII characters and display-control codes. Since the ASCII sequences are not dependent upon software language, the InfoTouch Display can be used with virtually any host computer. And since the displays are stored in your computer's software or firmware, changes can be easily made as you update the capabilities of your system.

The standard InfoTouch Display allows display of the full ASCII character set plus eleven standard graphics characters for creating simple line drawings or outlining touch-sense areas. Expanded graphics capabilities are optionally available via the 1780A-201 Expanded Graphics Character Set. This option provides 128 more graphics characters to let you generate complex process diagrams or other graphic displays. Or, if you like, you can customize the character sets for your particular system needs.

OEM Configurations and Uses

The 1780A features a compact, rugged display ideally suited for incorporation into your system. It is equally at home sitting on a desk or bench, mounted into a standard 19" rack, or installed into a custom enclosure with other system components. Special configurations and quantity discounts are available to Original Equipment Manufacturers. Contact your Fluke Sales Engineer or Representative for complete information.

System Compatibility

The 1780A InfoTouch Display connects directly to any host computer with a standard RS-232-C interface. If your system can communicate with a conventional terminal, it can work with the 1780A. RS-422 communication capability is available in special configurations. Contact your Fluke Sales Engineer or Representative for complete information.

Fluke's 1720A and 1722A Instrument Controllers and 1752A Data Acquisition System are also suitable hosts for the 1780A, particularly in test and calibration systems employing IEEE-488 instrumentation. The character set and display control sequences are similar between the 1780A and the 1720A, 1722A and 1752A allowing the 1780A to be a remote operator interface to these devices.

INFOTOUCH® DISPLAY

1780A

Display Features

- 60 distinct touch-sensitive blocks on the display screen
- High resolution green display for operator eye comfort
- Large display capacity — 16 full-width 80 character lines
- Double-size character display mode
- ANSI standard display control codes
- Full cursor position and screen erase controls
- Underlining, blinking, reverse image, and highlighting
- Eleven standard graphic characters
- Optional alternate character set adds 128 characters for expanded graphics or international applications
- All display characters user-definable in EPROM

Relevant choices shown graphically

Call up a menu when needed

International Design Standards

The 1780A InfoTouch Display is designed for the international market. It automatically senses and adjusts its display scan for 50 Hz or 60 Hz power supply. Interconnection is through the widely accepted RS-232-C standard, using standard baud rates, ASCII codes, and ANSI-defined display control sequences.

Custom character sets can be easily designed to facilitate virtually any international application.

Optional Keyboard Interface

The Keyboard Interface Option (-001) gives the 1780A another input and output mode in addition to the touch sensitive screen. It may be used with a customized keypad, test fixture, or with the Y1720 Programmer Keyboard for operation as a standard terminal. There are also five TTL output lines on the interface which can be controlled through remote commands from the host.

Accessory Descriptions

Y1791 is a rack mount adapter with a blank filler panel. It allows the 1780A to be mounted to either the right or left side of standard 19-inch rack enclosures. Rack slides or a rack shelf are required for complete mounting of the 1780A in a rack.

Y1792 is a rack mount adapter with a keyboard extension cable. It is similar to Y1791 but includes an extension cable mounted to the filler panel which will extend the function of the 1780A-001 Keyboard Interface to the front panel. Rack slides or a rack shelf are required for complete mounting of the 1780A in a rack.

Y1793 is a carry handle that can be easily installed in place of the trim on either side of the 1780A.

Y1720 Full ASCII keyboard.

Specifications

Signal Emissions: FCC Part 15, Subpart J, Class A
Temperature: 0°C to 50°C, operating; -40°C to +65°C, non-operating
Relative Humidity: To 95% from 0°C to 25°C, 75% to 40°C, and 45% to 50°C, non-condensing
Power: 90V to 132V ac, or 198V to 264V ac, 47 to 63 Hz, 55W maximum
Size: 13.3 cm H x 28.8 cm W x 34.4 cm D (5.23 in x 11.35 in x 13.55 in). Standard 5¼-inch rack height
Weight: 9.7 kg (22 lb)

Model

	January 1986 prices
1780A InfoTouch Display	$1995

Options

1780A-001* Keyboard Interface	150
1780A-002* Keyboard Interface with Y1720 Keyboard	400
1780A-201 Expanded Graphics Character Set	250

**Customer installable*

Accessories (Also see page 230)

Y1702 2m RS-232-C Null Modem Cable	125
Y1703 4m RS-232-C Null Modem Cable	150
Y1705 0.3m RS-232-C Null Modem Cable	75
Y1707 2m RS-232-C Cable	125
Y1708 10m RS-232-C Cable	150
Y1720 Keyboard	350
Y1791* Rack Adapter	95
Y1792* Rack Adapter and Keyboard Cable	195
Y1793 Carry Handle	40
M00-260-610 18" Rack Slide Kit	105
M00-280-610 24" Rack Slide Kit	110

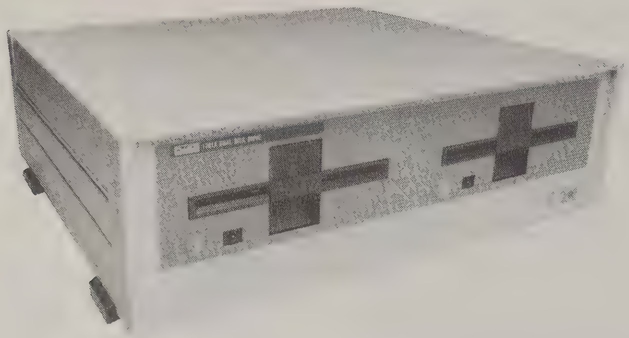
**Separately order rack slides M00-260-610 or M00-280-610*

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

DISK DRIVE SYSTEMS

1760A/1761A Disk Drives



1761A Dual Disk Drive

1760A/1761A Disk Drive Systems

- Compatible with IEEE-488 bus controllers
- Software supported for Fluke 1720A, 1722A, and 1752A Instrument Controllers
- 400K bytes of on-line capacity (1760A)
- 800K bytes of on-line capacity (1761A)
- Low EMI and RFI emissions, designed for lab environments
- Rack mountable
- Automatic self-test
- Double-density, double-sided format
- 1720A single-sided format also supported

The Fluke 1760A Disk Drive and 1761A Dual Disk Drive each provide high capacity floppy disk file storage for IEEE-488 bus systems. Rack mountable and supported with software for 1700 Series Instrument Controllers, you will find them easy to install and use. Installation is a matter of mounting and connecting the IEEE-488 bus cable. When used with a Fluke 1720A or 1722A Instrument Controller or the 1752A Data Acquisition System, you will not need to be concerned with events and protocol on the IEEE-488 bus: available software for the Controllers allows either disk drive to be treated by application programs as if it were simply an additional drive installed in the controller.

Support software available for the 1722A Instrument Controller and 1752A Data Acquisition System is provided with the controller. For use with the 1720A Instrument Controller, the Configured System Software Option (1720A-700) must be separately ordered. When ordering Option -700 for the 1720A, be sure to include a complete list of options and peripheral devices used. The Configured System Software works even if the supported devices are not yet installed.

Specifications

Access Time: 505 ms, average
Transfer Rate: 50K bytes per second, burst; 12K bytes per second, average, with typical sector interleave
On-line Capacity: 400K bytes with 1760A, 800K bytes with 1761A
Track Density: 48 tracks per inch
Speed: 300 revolutions per minute
Recording Format: 512 bytes per sector, 10 sectors per track, and 40 tracks per side (80 total). Double-density encoding
Disk: Fluke-qualified industry-standard 5.25 inch, certified double-density, 40 tracks, both sides
Disk Life: More than 3 x 10^6 revolutions with head contact, per track
Error Rates: 1 bit per 10^9, recoverable; 1 bit per 10^{12}, non-recoverable

General Specifications

Signal Emissions: FCC Part 15, Subpart J, Class A; VDE 0871, Class B; CISPR 11-1975
Temperature: 10°C to 40°C, operating; -10°C to 60°C, non-operating
Relative Humidity: 20% to 90% from 10°C to 30°C, 20% to 80% from 30°C to 40°C, operating; 5% to 95%, non-operating
Power: 90V to 110V ac, 108V to 132V ac, 198V to 242V ac, or 216V to 264V ac, selectable, 47 to 63 Hz. 55W for 1760A, operating; 70W for 1761A, operating
Size: 13.3 cm H x 43.2 cm W x 39.6 cm D (5.25 in x 17.0 in x 15.6 in), both models
Weight: 1760A is 7.7 kg (17 lb), 1761A is 9.1 kg (20 lb)

Models

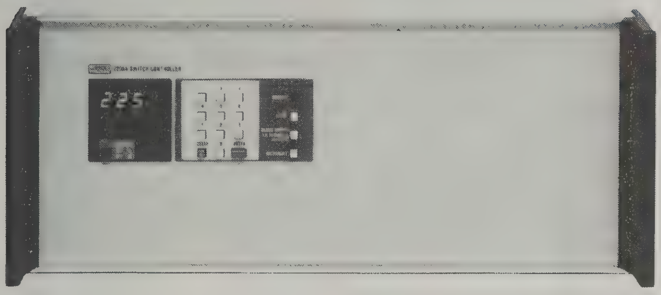
	January 1986 prices
1760A Disk Drive System	$1950
1761A Dual Disk Drive System	2950

Options

1720A-700 Configured 1720A System Software	95
Y1706 Double-Sided Blank Disks (pkg. of 10)	100
Y1790 Rack Mount Kit with 24" Slides	175
Y1794 Rack Mount Kit with 18" Slides	175
Y8021 1m IEEE-488 Cable	85
Y8022 2m IEEE-488 Cable	95
Y8023 4m IEEE-488 Cable	105

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.



2205A

2205A Switch Controller

- Plug-in modules that expand the versatility of the 2205A
- Channel expansion (up to 1000)
- Matrix latching
- Low level and thermocouple scanning
- Two-wire or four-wire resistance scanning
- Actuator/Relay control
- Remote operation via IEEE-488 or RS-232-C interface options

Versatile Switching, Latching, Scanning

The microprocessor-based 2205A Switch Controller offers a wide variety of switching, scanning, and matrix-latching capabilities for applications in production testing, process monitoring, process automation, calibration, etc.

The 2205A may be operated or programmed from the front panel to perform periodic switching operations. Or it may be directed remotely in a system compatible with IEEE Std 488-1978 or EIA Standard RS-232-C to perform complex switching operations.

Five Switching Options

Five kinds of switching module options are available. They plug into the 2205A mainframe and any combination of up to ten modules may be plugged in at the same time. Model 2201A Extender Chassis allows for expansion of a system to accommodate up to 100 modules.

Three of the five types of switching options are for scanning analog signals and measuring them with a DMM. One of the three is for measuring low level signals such as the output voltage from thermocouples (-600), one is for general-purpose scanning (-300), and one is for measuring resistances using 4-wire connections (-400). Four wires are needed for precision measurements of low resistance values through long input wires. The latter option uses a pair of modules: a general-purpose module for the current-source leads and a low-level module for the voltage-sense leads.

Each module has ten reed relays and will scan ten points. The low-level reed relays switch a guard line as well as a pair of input leads.

Option -100 is an actuator module with five medium-power relays for controlling external and remote devices like indicators, actuators, alarms, power supplies, and other relays.

Option -200 is a matrix latching module that may be configured in one of three ways: either as a 1 by 8 matrix, as two 1 by 4 matrixes, or as a 2 by 4 matrix. This option features an 8 millisecond break-before-make switching speed and less than 10 microvolts of thermal offset.

Integrated Stimulus, Measurement, Control

The modularity of the 2205A makes it easy to configure switching in numerous ways. And that makes it a worthy building block for automated systems of various kinds. With either the RS-232-C Option (-060) or the IEEE-488 Option (-050), the 2205A can become an integral part of a sophisticated system. Fluke offers numerous IEEE-488-compatible instruments including the 1722A or 1752A Instrument Controller, signal sources, power sources, calibrators, digital voltmeters, counters, thermometers, data loggers, and printers.

2205A Specifications

Control: Manual, panel-programmed scan, or via RS-232-C or IEEE-488 Interface Option
Panel Controls: Select channels to be scanned, actuated, or latched. Scan rate selectable in 0.1 second increments from 0.2 seconds to 3.3 seconds per channel using behind-the-panel control.
Switch-Module Slots: Ten, expandable to 100 using several 2201A (12-slot) Extender Chassis
Display: 3-digit LED. Shows active channel number. Also shows assigned address (using IEEE-488 Interface), or selected baud rate (using RS-232-C Interface) at time of power-up.
Trigger Output: Rear panel BNC connector. TTL level. Adjustable delay. To trigger measurements following moments when switching occurs.
Analog Output: To digital multimeter via rear panel output connector. Guarded 2-wire or guarded 4-wire connections. Common-mode voltage 170V dc or peak ac.
Other Inputs and Outputs: Via module connectors included with modules
Internal Scanning Bus: Two 3-wire buses. One is common to even-numbered module slots; the other is common to odd-numbered slots. Goes to analog output. Input resistance is greater than 10 GΩ on HI or LO with respect to power line ground.

2201A Specifications

Switch-Module Slots: 12 in each 2201A. Up to 100 slots (1000 channels) per system.

One or more 2201A Extender Chassis may be connected to a 2205A via a six-foot cable supplied with each 2201A. Power and control for the modules is supplied by the 2205A.

2202A Specifications

Switch Module Slots: 10 in each 2202A. Up to 100 slots (1000 channels) per system.

Power for the modules is supplied from an ac line via internal dc supply. Requires 2200A-7001 and 2200A-7002 cable.

Option Specifications

Actuator Control Module Option (-100)

Relays: Five, SPDT
Switching Time: 20 ms*
Contact Rating: 1A maximum at up to 26V dc or 30V rms ac. 3A fuse in each common line
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -110K and -010K.

Matrix Latching Module Option (-200)

Relays: Eight, latching, DPST with unswitched guard, break-before-make
Switching Time: 8 ms*
Rating: 40 mA maximum to 170V dc or peak ac, max
Bandwidth: Dc to 1 MHz (±0.1 dB) into 600Ω to 1 MΩ load
Thermal Offset: <10 μV
Configurations: One 2x4 matrix, two 1x4 matrixes, or one 1x8 matrix
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -210 and -009K.

General-Purpose Scanning Module Option (-300)

Relays: Ten, reed type, DPST with unswitched guard
Scan Rate: 125 channels per second, maximum*
Rating: 40 mA maximum. A 0.5A fuse in each input line
Thermal Offset: <10 μV
Connectors: Screw terminals, three lines per relay. Terminals are mounted on an edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -310K and -009K.

Low-Level Scanning Module Option (-600)

Relays: Ten, reed type, 3PST, switched guard
Scan Rate: 80 channels per second, maximum*
Rating: 15 mA maximum to 35V peak
Reference Junction Output: 540 mV at 25°C
Thermal Offset: <1 μV
Connectors: Screw terminals on isothermal block to minimize temperature differences between terminals when scanning thermocouples. Reference junction temperature-sensing circuit on isothermal block provides automatic compensation to thermocouple output signals. Terminals are mounted on edge-card connector that plugs onto, and is easily removed from, the module circuit card. Comprised of -610K and -008K.

Four-wire Ohms Option (-400) (-300 plus -600)

Two modules per option, used in adjacent slots. Switch both current-source and voltage-sense connections for precision resistance measurements. Specifications for current sourcing are the same as for Option -300. Specifications for voltage sensing are the same as for Option -600, except reference junction temperature sensing circuits are not available. Comprised of -310K and -009K plus -610K and -008K. For application requiring more than 50 four-wire ohm circuits, the 2200A-7000/AU adapter and pairs of 2201A Extender Chassis are required.

RS-232-C Interface Option (-060)

Serial interface with a baud rate of 110, 134.5, 150, 300, 600, 1200, 2400, or 4800.

IEEE-488 Interface Option (-050)

For use in IEEE-488-compatible systems.
Repertoire: AH1, L2, RL1, DC1, E2

**These times are 2205A times and do not necessarily reflect system specs*

General Specifications

Temperature: 0°C to 50°C, operating; -55°C to +75°C, non-operating
Relative Humidity: ≤80% to 40°C, operating
Power: 100, 120, 220, or 240V ac ±10%, 50 to 60 Hz, selectable from rear panel. 25W maximum
Size: 17.8 cm H x 43.2 cm W x 44 cm D (7 in x 17 in x 17.4 in)
Weight: 7.1 kg (15.6 lb)
Included
2205A: Manual, power cord, 3-foot Y8076 analog output cable for 8502A-16, 8505A, 8506A, 8520A, or 8860A-06 DMM
2201A: Manual, six-foot cable for connecting to 2205A
2202A Manual, power cord but no cable

Models

January 1986 prices

2205A Switch Controller	$2130
2201A Extender Chassis	1645
2202A Extender Chassis	1975

Options

2205A-050	IEEE-488 Interface	270
2205A-060*	RS-232-C Interface	270
2205A-100	Actuator Control	360
2205A-200	Matrix Latching	360
2205A-300	General-Purpose Scanning	360
2205A-400	4-Wire Ohms Scanning	870
2205A-600	Low-level Scanning	510

**Can't be used with Option -050*

Accessories (Also see page 230)

2205A-110K Spare Actuator Card	320
2205A-010K Spare Actuator Connector	110
2205A-610K Spare Low-Level Scanner Card	400
2205A-008K Spare Low-Level Connector	110
2205A-310K Spare General-Purpose Scanner Card	320
2205A-009K Spare General-Purpose Connector	110
2205A-210K Spare Matrix Latching Card	320
2200A-7000/AU Multi-Channel 4 Wire Ohms Adapter	on req.
2200A-7001* Connector and Assembly of -7002	180
2200A-7002* Remote Scanner Cable (per foot)	6
Y8021 1m Cable for IEEE-488 Bus	85
Y8022 2m Cable for IEEE-488 Bus	95
Y8023 4m Cable for IEEE-488 Bus	105
Y8004 1.5m RS-232-C Cable	105
Y8013 Trigger Output Cable, 4-foot	25
Y8076 Analog Interface Cable (Included with 2205A) 3-foot	125
M07-205-600 7" Rack Adapter	105
M00-260-610 18" Rack Slides (needs M07-205-600)	105
M00-280-610 24" Rack Slides (needs M07-205-600)	110

**-7001 and -7002 both required*

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

BOARD TESTERS & TROUBLESHOOTERS

Increase Your Productivity With Affordable Board Testers and Troubleshooters

High Confidence Testing From Start to Finish

From initial circuit design and debugging and on through receiving inspection, loaded board test, functional test, rework, and factory, field, or third-party repair, Fluke board test and troubleshooting equipment helps you do your job more effectively. You'll keep throughput high and manufacturing costs and board float low. And when troubleshooting and repairs are needed, you'll reduce downtime and repair costs.

Early Defects Screening in Manufacturing

In electronics manufacturing, the earlier you catch a defect, the lower production costs will be — and the easier it will be to meet production quotas. Fluke's manufacturing defects analyzers, functional testers, and digital troubleshooters and accessories provide you with high confidence testing at every stage of the manufacturing process. Using Fluke board testers and troubleshooters, you can:

- Make sure your bare boards are fault-free before they leave receiving inspection, so you don't waste time and money loading good components onto defective boards.
- Test your boards after components have been inserted, quickly locating shorted, missing, incorrect, inverted, or dead components before going on to the more complex process of functional testing.
- Perform comprehensive functional tests on your loaded boards before installing them in your final system, locating those troublesome dynamic faults that appear only when components are interacting in sequence and at rated speed.
- Test hybrid boards as well as standard printed circuit boards, isolating analog faults down to the component level.

Easy Troubleshooting and Repair

In electronics servicing, the faster you find the problem, the lower your repair costs and downtime will be. Fluke equipment makes it easy to troubleshoot microprocessor-based circuits. We've reduced both the cost and the complexity of troubleshooting these systems, giving you the ability to quickly locate faults in either the kernel or peripheral circuitry. In fact, we've made the process so easy that you'll be successfully isolating and repairing faults the first day. Using Fluke's board testers and troubleshooters, you can:

- Troubleshoot and rework defective boards in your production facility, lowering your manufacturing costs by reducing both repair times and the percentage of waste.
- Test and service boards already installed in existing systems, isolating digital faults down to the component level.

In factory rework centers, factory repair depots, field service centers, third-party service centers, and in-house maintenance facilities, Fluke troubleshooting equipment and accessories simplify and speed micro-circuit repair.

Fluke Means Peace of Mind

When you choose Fluke board testers and troubleshooters, you choose reliability. Fluke has been designing successful test instrumentation for nearly 40 years, and we know how to build systems that will keep on working under the heaviest loads. Our 3050B Digital/Analog Functional Test System, for example, has a mean time between failures in excess of 1,000 hours — a record you'll find unmatched anywhere. And our 9005A, 9010A, and 9020A Troubleshooters are at work in demanding production and repair facilities around the world.

We also back each product with a commitment to customer support — a commitment evident in the breadth and depth of our training, in the worldwide availability of our service centers, and in the thoroughness of our documentation. When you choose Fluke board testers and troubleshooters, you get more than affordable, effective equipment: you also get the peace of mind that comes only with a supplier committed both to high-quality products and comprehensive support.

Selecting the Right Fluke Product

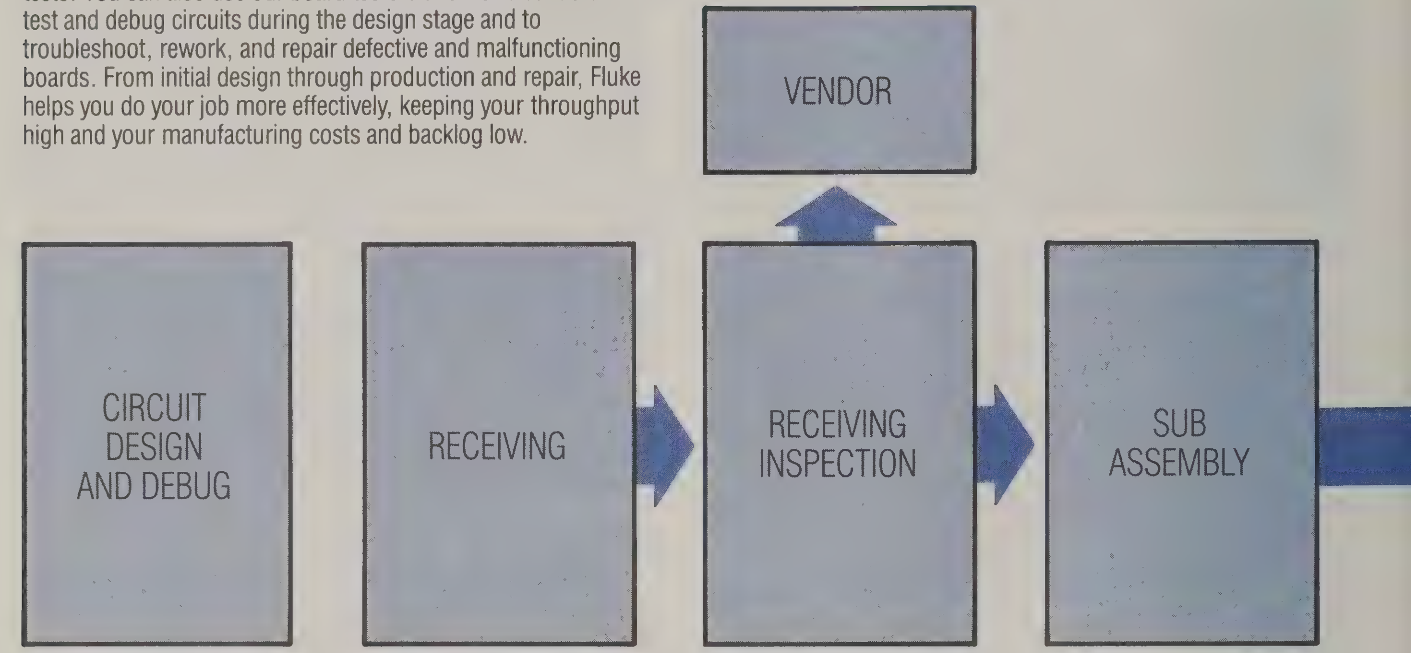
The following pages will help you find the Fluke board-testing products that best meet your needs. The flow chart on pages 210 and 211 shows you which Fluke equipment is appropriate for each stage of manufacturing and service. A selection guide comes next, on page 212, followed by detailed descriptions of each product. For your convenience, we've grouped product descriptions into three broad categories:

- **9000 Series Micro-System Troubleshooters**, for functional testing, rework, and repair of a high variety of microprocessor-based products under low-volume conditions.
- **Manufacturing Defects Analyzers**, for locating faults on bare and loaded boards, backplanes, card cages, and cables, before going on to functional testing.
- **Functional Testers**, for high-volume functional testing, rework, and repair.

IEEE-488

BOARD TESTERS & TROUBLESHOOTERS

Fluke's PC board testers and troubleshooters provide you with high-confidence testing for each phase of the manufacturing process, from receiving inspection through final factory tests. You can also use our board testers and troubleshooters to test and debug circuits during the design stage and to troubleshoot, rework, and repair defective and malfunctioning boards. From initial design through production and repair, Fluke helps you do your job more effectively, keeping your throughput high and your manufacturing costs and backlog low.

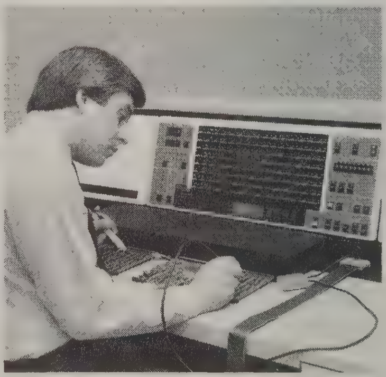


Circuit Design and Debug. Use the 9010A Micro-System Troubleshooter during the design engineering stage to test and debug prototype circuits, so you'll know they function as intended before building them into a product.

Receiving Inspection. Use the 3200B Manufacturing Defects Analyzer to make sure your bare boards are fault-free before they leave receiving inspection. That way, you won't waste time and money loading good components onto defective boards.

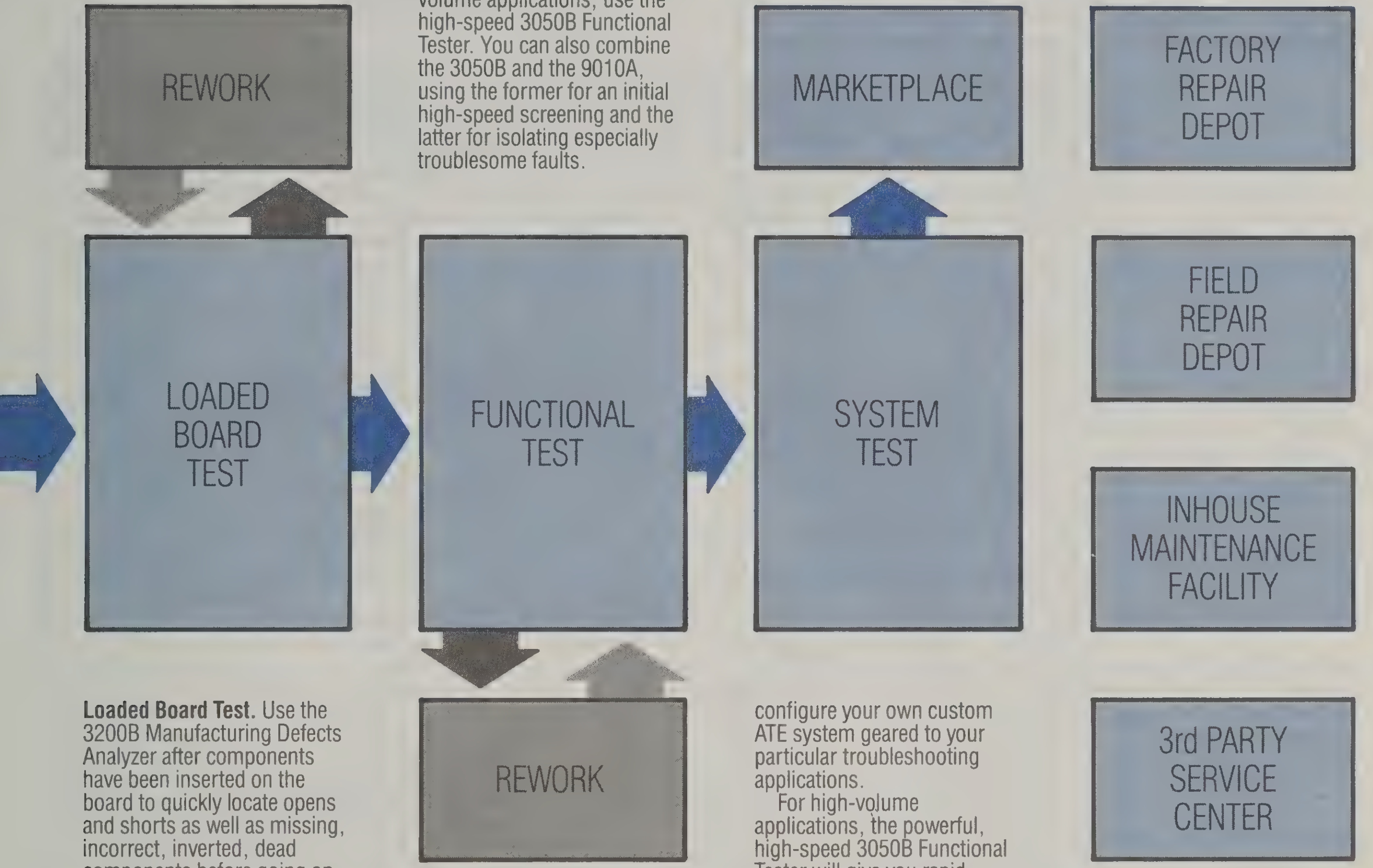
9000 Series Micro-System Troubleshooters

3200B Manufacturing Defects Analyzer



3050B Functional Test System

Rework. You can substantially lower your manufacturing costs by reworking defective boards instead of discarding them. For low-volume applications, use the 9000 Series Micro-System Troubleshooter; for high-volume applications, use the high-speed 3050B Functional Tester. You can also combine the 3050B and the 9010A, using the former for an initial high-speed screening and the latter for isolating especially troublesome faults.



Loaded Board Test. Use the 3200B Manufacturing Defects Analyzer after components have been inserted on the board to quickly locate opens and shorts as well as missing, incorrect, inverted, dead components before going on to the more complex process of functional testing.

Functional Test. For low-volume applications, use the 9000 Series Micro-System Troubleshooter to perform comprehensive functional tests, isolating dynamic faults with the board running at speed. Or, for testing products combining digital and analog circuitry, choose the 9020A, with an RS-232C or IEEE 488 interface. By integrating the 9020A with a system controller and analog test instrumentation, you can configure your own custom ATE system geared to your particular troubleshooting applications.

For high-volume applications, the powerful, high-speed 3050B Functional Tester will give you rapid throughput, fully testing an entire board for dynamic faults in five seconds or less. And, if your product uses hybrid boards, adding a 3053B Analog Test Station to your 3050B will give you high-volume troubleshooting of both digital and analog circuitry.

Whatever your production environment, Fluke board testers and troubleshooters will handle your toughest functional testing challenges with confidence levels of 98% or higher.

Repair Depots. Whether your repair application is in factory or field, at a third-party service center or an in-house maintenance facility, you'll find the 9000 Series make it easy to isolate and repair the most challenging faults. In high-volume factory repair depots, choose the 3050B Functional Tester for higher-speed performance of the same comprehensive diagnostics.

BOARD TESTERS & TROUBLESHOOTERS

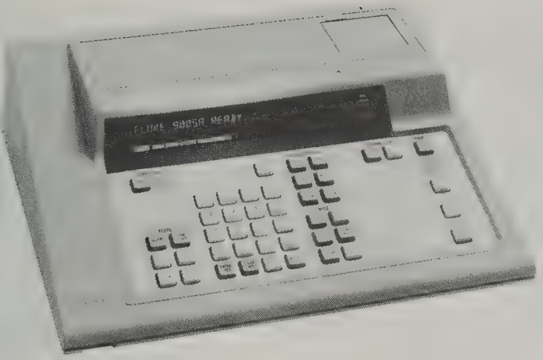
Affordable Board Test and Troubleshooting Equipment for a Range of Applications

Use this handy selection guide to determine which Fluke board testing and troubleshooting equipment to investigate further for your specific needs. **The exact selection of equipment for your needs is best determined by a careful analysis of many factors including work load and work rate, operator skill and efficiency, labor rates, types of defects, as well as financial and tax variables.** Call on your Fluke sales specialists for assistance in equipment analysis and justification.

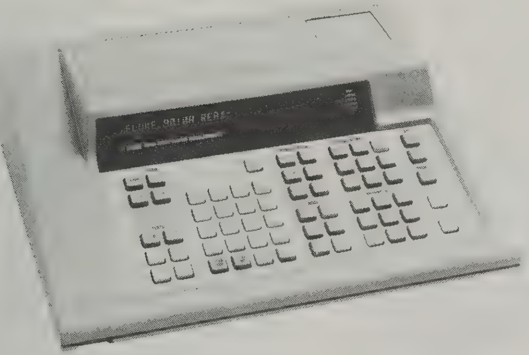
	9005A Micro-System Troubleshooter	**9010A Micro-System Troubleshooter**	**9020A Micro-System Troubleshooter**	**3200B Manufacturing Defects Analyzer**	**3050B Functional Tester**
Key Functions	Testing and troubleshoot microprocessor based systems with test routines for locating faults related to the microprocessor bus (RAM, ROM, I/O). Includes probe to monitor logic action on a node-by-node basis or to inject stimulus pulses.			High-speed testing of bare & loaded boards, back-planes, cables and harnesses for shorts, opens, missing, incorrect, inverted or dead components.	Digital/Analog functional testing by comparing to known-good reference board or single board test using signature based diagnostics.
	Uses test programs downloaded from a 9010A or from pre-recorded mini-cassette.	Self-contained programmability. Can use pre-recorded cassette or be programmed from PC.	For use in systems with a controller or personal computer via either RS-232 or IEEE-488.		
Other Features and Accessories	● Asynchronous Signature Probe for circuits far from the microprocessor: DMA Controllers, Disk Controllers, Video Controllers and Generation Circuits, Communication Circuits, Peripheral Controllers ● PC Tester Software for 9000 Series use in repairing IBM PCs. ● Supports over 50 Microprocessors (see page 215).			● Multi-site testing ● Industry leading measurement accuracy and range specifications. ● High-quality low-cost fixturing	● Can add Fluke Touch-Sensitive display ● Analog option to test analog waveforms
Location of Typical Use ● Design	C	A	A	C	C
● Receiving Inspection	C	C	C	A	C
● Production	A	A	A	A	A
● Rework	B	A	A	B	A
● Factory Service	A	A	A	C	B
● Field or 3rd Party Service	A	A	B	C	B
● In-House Maintenance	B	A	C	C	C
Quantity and Variety of Boards					
● High volume, low variety	C	C	B	A	A
● High volume, high variety	B	B	B	A	A
● Low volume, low variety	A	A	B	B	B
● Low volume, high variety	A	A	A	B	B

A = Most recommended
B = Recommended in certain applications
C = Not recommended except for special applications

9000 Series



9005A



9010A

9020A

9000 Series Micro-System Troubleshooters

- Preprogrammed kernel test routines
- Simple peripheral troubleshooting
- Keyboard data entry
- 32-digit display
- Power-up self-test
- Keystroke programming (9010A only)
- Language compiler optional (9010A only)
- Communications interface (RS-232C is optional for 9005A and 9010A; either RS-232 or IEEE 488 is standard for 9020A)

Partial List of Processors Supported

1802
1804
1805
1806
6502
6800
68000
68010
6802
6802NS
6808
6809
6809E
80186
80188
8031
8032
8035
8039
8040
8041
8041A
8042
8044
8048
8049
8050
8051
8052
8080
8085A
8085A-2
8086
8088
8344
8741
8741A
8742
8744
8748
8749
8751
9900
Z8001
Z8002
Z8003
Z8004
Z80A
Z80B

The 9000 Series Micro-System Troubleshooters — 9005A, 9010A, and 9020A — are among the most comprehensive troubleshooting instruments ever developed for locating faults on microprocessor-based systems. They include built-in preprogrammed test routines for automatically checking the entire microprocessor kernel: bus, RAM, ROM, and I/O. They also include a troubleshooting probe that you can use either to monitor logic action on a node-by-node basis or to inject stimulus pulses.

The three troubleshooters differ primarily in their programming and system capabilities.

The 9010A is a self-contained, programmable model that lets you develop your own customized test programs. Using the 9010A, you can perform specialized guided fault-isolation routines on any portion of a board's digital circuitry. This troubleshooter also includes a LEARN algorithm that will generate a memory map from a known-good board.

The nonprogrammable 9005A includes the same built-in tests as the 9010A but cannot generate new test routines — nor does it include the LEARN algorithm. It can, however, run test sequences developed on the 9010A and downloaded from a minicassette tape. With the optional RS-232C interface, you can also download test sequences directly from the 9010A or a host computer. Typically, you would develop guided fault-isolation programs at a central location, using a 9010A, and then run the programs at remote sites on 9005As.

The 9020A, designed for systems use, runs test programs written and stored in a system controller or other computer. You can also combine the 9020A with other test instruments to troubleshoot complex microprocessor-based products with special measurement and control problems. The 9020A has no programming keys or cassette tape capability, so test sequences must be downloaded through the RS-232C or IEEE 488 port.

Read/Write Emulation

The 9000 Series Micro-System Troubleshooters eliminate tedious, manual probing techniques. Instead, they take control of the unit under test by plugging into its microprocessor socket. They then emulate the actions of the micro-processor, both reading data from and writing data to the unit's RAM, ROM, and I/O addresses.

Built-in Tests

Fluke has taken the trouble out of verifying that the kernel — the heart of the microprocessor system — is operating properly, by including built-in kernel tests in all the 9000 Series Troubleshooters. These tests, initiated by a single keystroke, check the electrical integrity of the microprocessor bus, the read/write capability of the I/O registers, the data in ROM, and RAM operation. A fifth built-in test provides more extensive RAM tests when necessary, checking for pattern-sensitive failures.

The five tests, which cover more than 50% of the components on most boards, check for the problems that are often the most difficult to identify and isolate — including failures that lock up the microprocessor bus. Even if the troubleshooters had no other capabilities, the time saved by these built-in tests alone would more than justify their cost.

BOARD TESTERS & TROUBLESHOOTERS

9000 Series

Of the five built-in tests, you should run the bus test first, since it verifies the integrity of the microprocessor's basic communication network. To test the remainder of the kernel, you need to enter the location of RAM, ROM, and I/O on the unit under test, so the troubleshooter will know what addresses to read from and write to. You can enter this information manually through the front-panel keyboard or download it from a minicassette — or, if you have the RS-232C interface, you can download it from a host computer or system controller. If address information is not readily available from the unit's documentation, the LEARN algorithm will let you generate a memory map from a known-good board. Once entered, memory-map information can be stored on a minicassette for later use.

Beyond the Bus

The 9000 Series Troubleshooters aren't limited to finding bus-related problems: they can also isolate failures in synchronous circuitry outside the bus. The troubleshooting probe that comes with the 9000 Series will help you track such off-the-bus failures to their source. This probe is a powerful fault-finding tool, useful both for monitoring logic action and for injecting stimulus pulses.

In monitoring, or response mode, the troubleshooting probe takes signatures, counts events, and shows high/low logic states in each node probed. In stimulus mode, it can inject high or low pulses to stimulate readouts, print heads, interfaces, or other devices. Driven by a sync pulse from the interface pod, the probe can be synchronized to various microprocessor events, such as valid address or data periods on the microprocessor bus. You can also choose to use it in "free run" mode, injecting 1 kHz pulses at the specified nodes.

To further extend the capabilities of the troubleshooting probe, add the asynchronous signature option. This option lets you test asynchronous circuits located outside the microprocessor bus structure (such as DMA controllers, video controllers, and video-generation circuits) without using a logic analyzer or oscilloscope. Tests performed include signature gathering, waveform capture, and event counting. For more information, see the description of the Asynchronous Signature Probe Option.

Custom Test Programming on the Fluke 9010A

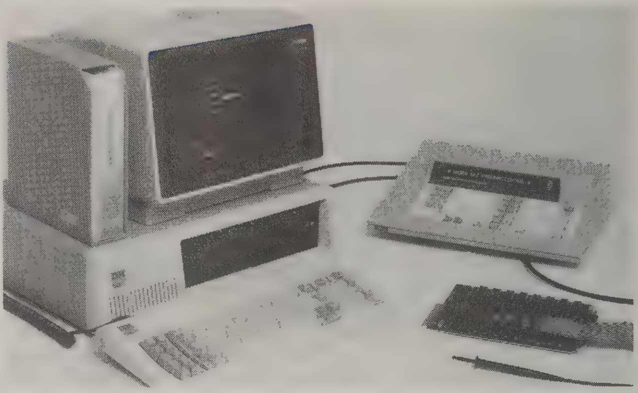
The 9010A lets you write your own comprehensive test routines tailored to the unique characteristics of the equipment you service. These programs can include prompting messages to help guide your technicians through the test procedures. Once written, your test programs can be stored on minicassettes for later use — or for downloading to a 9005A.

You can generate your own test software in two ways. First, you can develop short programs right on the 9010A's keyboard, in much the same way as with a scientific calculator. Second, for more extensive test routines, you can use the 9010A's Language Compiler, developing programs off-line on a personal computer and then downloading them to either a 9010A or a 9005A. The Compiler runs on a number of popular personal computers, including the IBM® PC and Kay Pro II® as well as on the Fluke 1720A and 1722A Instrument Controllers. For more information, see the description of the Language Compiler on page 216.)

A Powerful Test System Using the Fluke 9020A

The combination of a Fluke 9020A Micro-System Troubleshooter with an IBM or IBM-compatible personal computer and Fluke's TestWriter™ software (see page 217 for more information) gives you a powerful system for performing large-scale guided fault-isolation. In this system, the 9020A is used to stimulate and gather response information from the unit under test; the personal computer acts as both the system controller and the storage medium; and the TestWriter software minimizes programmer time through simplified data-entry procedures.

This test configuration makes developing test programs so easy that it opens the door to new types of tests — tests that previously would have required too much programming time to be cost-effective. And it makes performing the tests so simple that virtually any technician can immediately begin troubleshooting, without going through the extensive training required to use more traditional test techniques.



Controlling the 9020A Remotely Via a PC, Using TestWriter

Interface Pods

- 49 microprocessors supported (January 1986)
- Adapter kits available for other microprocessors
- Easy connection to unit under test
- Intelligent pods with built-in software*
- Quick memory tests*
- Quick looping Reads and Writes*
- Built-in self-diagnostics

**Available on some pod models only. See Table 1 for a listing of pods offering these features.*

How the Interface Pod Works

The interface pod functions as the test interface between the suspect circuit board and the troubleshooter mainframe, adapting the general architecture of the mainframe to that of the specific microprocessor system under test. When you plug the pod into the unit under test, you are effectively replacing the microprocessor in that unit with the microprocessor in the pod.

IBM is a registered trademark of International Business Machines Corporation. Kay Pro II is a registered trademark of Non-Linear Systems, Inc.

This unique test connection gives the Fluke troubleshooter mainframe the ability to access board and system components *directly,* through the central control element of the entire system — the microprocessor. As a result, you get exceptionally high-confidence test results.

Unlike emulators and development systems intended for software debugging, these interface pods are designed specifically for hardware troubleshooting. Each pod is a self-contained system with its own microprocessor, RAM, ROM, and I/O memory space. This means that the unit being tested does not need to be operating for the Fluke troubleshooter to begin testing. It also means that you can test for multiple faults by simply disabling each faulty line as it is identified and continuing to run the tests.

Each pod includes a RUN UUT function to let you test the unit's operation as though it were operating under its own microprocessor. When this function is activated, it electrically disconnects the unit being tested from the pod, letting it perform as if its microprocessor were still in the socket.

Microprocessors Supported

Fluke interface pods currently support an extensive range of microprocessors, as shown in Table 1. New pods are added regularly to support additional microprocessors as they are introduced.

The interface pod obtains its clock signal from the unit under test and runs at the same speed as the unit. Since manufacturers often build a particular microprocessor in different versions, each running at a different clock speed, Fluke selects the fastest clock speed available when designing its pods. In this way, it ensures the pod's ability to test any processor in that family, regardless of clock speed.

Advanced Pod Features

As microprocessor technology advances, Fluke has made its pods correspondingly larger and more powerful. Accordingly, the newer pods (indicated by an * in Table 1) offer advanced features not available in some of the earlier models. These include more intelligence, interrupt features, quick memory tests, and quick looping read and write tests.

Table 1. Microprocessors Supported by Fluke Interface Pods

System μP	Pod Model #	System μP	Pod Model #
1802	9000A-1802*	8048	9000A-8048*
1804	9000A-1802*	8049	9000A-8048*
1805	9000A-1802*	8050	9000A-8048*
1806	9000A-1802*	8051	9000A-8051*
6502	9000A-6502	8052	9000A-8051*
6800	9000A-6800	8080	9000A-8080
68000	9000A-68000*	8085A	9000A-8085
68010	9000A-68000*	8085A-2	9000A-8085
6802	9000A-6802	8086	9000A-8086*
6802NS	9000A-6802	8088	9000A-8088*
6808	9000A-6802	8344	9000A-8051*
6809	9000A-6809	8741	9000A-8048*
6809E	9000A-6809	8741A	9000A-8048*
80186	9000A-80186*	8742	9000A-8048*
80188	9000A-80188*	8744	9000A-8051*
8031	9000A-8051*	8748	9000A-8048*
8032	9000A-8051*	8749	9000A-8048*
8035	9000A-8048*	8751	9000A-8051*
8039	9000A-8048*	9900	9000A-9900
8040	9000A-8048*	Z8001	9000A-Z8000*
8041	9000A-8048*	Z8002	9000A-Z8000*
8041A	9000A-8048*	Z8003	9000A-Z8000*
8042	9000A-8048*	Z8004	9000A-Z8000*
8044	9000A-8051*	Z80A	9000A-Z80
		Z80B	9000A-Z80/AA

**Incorporates one or more advanced features (see discussion under "Advanced Pod Features" in this section.*

Note: For microprocessors not found in this table, contact your local area Fluke Sales Office or Representative for a copy of Technical Data B0156, "User-Designed Interface Pod Adapters."

More Intelligence. Many of the newer pods feature additional built-in software, enhancing the troubleshooting and test capabilities of the mainframe. With this software, the user need only send the test parameters to the pod from the troubleshooter mainframe. The pod will independently execute the specified function, providing much faster test results than is possible with mainframe execution.

Interrupt Features. Some of the newer pods also have interrupt testing capabilities, allowing them to read information from received interrupts. The user can control the configuration of the pod's interrupt lines, enabling and disabling interrupts and forcing interrupt-acknowledge cycles.

Quick Memory Tests. Fluke has increased the speed of memory testing in many of its newer pods, including the 8051, 8086, 8088, Z8000, 68000, 80186, and 80188, building Quick RAM and Quick ROM tests into the pod software. In addition to greatly reducing the test time, these tests provide:

- A choice of byte or word test for the 16-bit microprocessors
- A choice of address increment size
- More flexibility under program control

The Quick RAM test consists of two parts. The first rapidly tests the read/write capabilities of either small segments of memory or the entire block of RAM, verifying that memory addresses are being properly decoded. The second, a pattern verification test, checks dynamic RAM memory for refresh problems, verifying its ability to retain accurate information.

The Quick ROM test uses a checksum procedure to test the ROM for faults. It also finds any inactive data bits (bits that always read high or low regardless of the ROM address selected).

Quick Looping Read or Write. The Quick Looping Read or Write function rapidly performs continuous Reads or Writes at a specified address. This features lets you easily view bus signals on an oscilloscope synchronized to the TRIGGER OUTPUT pulse (located on the rear panel of the Troubleshooter). By increasing the repetition rate of the oscilloscope trace, this function makes the trace signal brighter and therefore easier to see.

Special Circuitry

Because the pod is intended to be used with defective micro-systems, Fluke designed it with special input protection circuitry. This circuitry provides overvoltage protection on each line to the unit under test — even if the pod is plugged in backwards. Other pod circuitry monitors and checks each read/write operation as it is performed. A self-test socket is included for verifying proper pod function.

Options and Accessories

9000A-910 Utility Tape

The 9000A-910 Utility Tape contains many programs designed to enhance the operation of the 9010A. These include:

- Merge Tape — Lets you read specific programs from a cassette tape, renumbering them as desired and merging them with programs already in the 9010A. With this utility, you can combine programs from two or more tapes onto a single tape.
- Frequency Counter — Lets you use the troubleshooting probe to measure frequencies of up to 6 MHz.
- Setup — Lets the 9010A operator make changes in the setup menu while the system is under program control.
- Probe Pulser — Lets the 9010A operator change pulser status while the system is under program control.
- Register Addition and Subtraction — Allows for the addition or subtraction of the contents of two registers while the system is under program control.

The Utility Tape comes with a manual that describes how to use each of these programs.

BOARD TESTERS & TROUBLESHOOTERS

9000 Series

9010A Language Compiler

If your test routines are short, you can develop them right at the keyboard of the 9010A. For more extensive test routines, you'll find it easier to work off-line on a personal computer, using the 9010A Language Compiler and downloading the results to the 9010A.

The Language Compiler lets you write extensive test and troubleshooting routines more quickly and conveniently than ever before. The Compiler is available in several versions, offering compatibility with the following computer systems:

- IBM™ Personal Computer
- Kay Pro™ II
- Fluke 1720A and 1722A Instrument Controllers

Sophisticated development tools come with the Compiler to speed the program-development process. Using these features, you can:

- Share common test routines among multiple programs through a File Inclusion features, linking them together automatically at compile time.
- Save time when entering code by using keyword abbreviations, optional command keywords, and shorthand notations.
- Assign symbolic names to your programs, labels, and registers, making it easier to understand and remember the purpose of the different program sections.
- Document programs with comments imbedded within the program listing, making them easier to follow should you later wish to revise them.

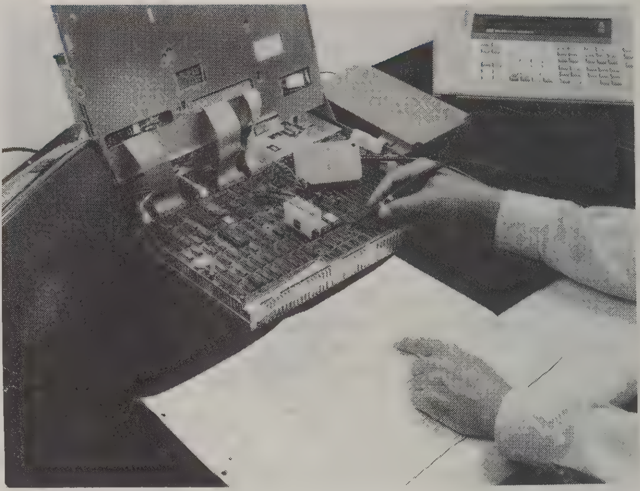
9000A-006 Asynchronous Signature Probe Option

The 9000A-006 Asynchronous Signature Probe Option gives you high-powered fault isolation capabilities for asynchronous circuits located outside the microprocessor bus structure. With this option, you no longer need to augment your 9000 Series Troubleshooter with a logic analyzer or oscilloscope.

By adding the Asynchronous Signature Probe to your Fluke troubleshooter, you gain the ability to perform real-time measurement of such asynchronous circuits such as:

- DMA controllers
- Video controllers
- Video-generation circuits
- Communication circuits
- Peripheral controllers

The Asynchronous Signature Probe provides three distinct troubleshooting measurements:



- Signature gathering, using the cyclic redundancy check technique.
- Waveform capture, in which the probe-tip data stream is sampled every 20 nanoseconds for a total of up to 32 data samples. The results of this sampling are both displayed and stored.
- Event counting, a powerful tool for node characterization. Using this features, you can count events from the probe tip, either continuously or through a measurement window. A 24 bit register allows you to record over 16 million events.

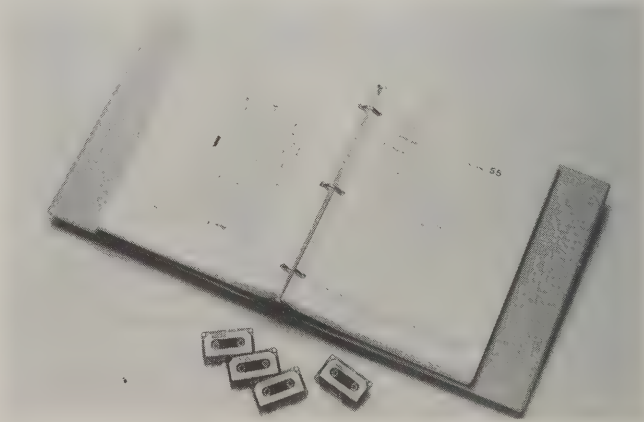
The Asynchronous Signature Probe consists of a circuit board, installed in the 9000 Series mainframe; a clock module, which picks up timing and control signals from the unit under test; and a special set of operating programs contained on a minicassette tape.

9000A-950 PC Tester

PC TESTER offers a quick, inexpensive way to troubleshoot and repair IBM® PCs, using both functional and guided fault-isolation techniques. The test software, developed by TECH PRO™, was specifically designed for use with Fluke's 9005A or 9010A Micro-System Troubleshooter and 8088 Microprocessor Interface Pod.

PC TESTER is so easy to use that virtually any repair person, regardless of skill level, can begin troubleshooting IBM PCs immediately. It's also quick: it can isolate the faults in any of the IBM PC's major circuit boards in less than 30 minutes (compared to two hours or more with normal troubleshooting methods). And, in more than 90% of the cases, it will isolate faults to a specific chip, saving you the cost of replacing the entire board.

The test programs are stored on minicassette tapes, which are easily loaded into the 9005A or 9010A. Once initiated, the software automatically triggers a series of functional tests from the 9005A or 9010A to



identify which type of circuitry is malfunctioning. Next, guided fault-isolation routines lead the operator through the board on a step-by-step basis. At each node, the software stimulates the circuitry with a variety of signals, compares the response data with known-good data, and tells the operator whether the component in question is functioning properly.

These techniques are so comprehensive that they allow you to test an IBM PC even when it can't boot. The only requirements are a functional power supply, a system clock, and a microprocessor socket.

9020A-925 TestWriter

Fluke's TestWriter software, combined with the 9020A Micro-System Troubleshooter, an interface pod, and an IBM (or IBM-compatible) personal computer, makes it easy to develop your own guided fault-isolation programs for digital circuit testing. In this configuration, the personal computer, communicating with the 9020A-001 through its RS-232C interface, acts as both a system controller and a storage medium.

TestWriter is especially helpful for developing large-scale guided fault-isolation programs — both because of the large amount of memory in the personal computer and because of the time-saving features of the software. Using TestWriter, a test engineer can realize as much as a five hundred percent increase in programming efficiency.

To develop a TestWriter program, the test engineer begins by describing the board to be tested. TestWriter's built-in fault tree makes this simple, since it eliminates the time-consuming process of entering individual decision statements. The test engineer simply enters the type and interconnectivity information for the unit unter test, and then creates a stimulus routine for the circuit; the fault tree does the rest.

The next step is to gather reference data from a known-good unit. Using the 9020A and the appropriate interface pod, the test engineer stimulates each node of the reference unit's circuitry, with the personal computer recording and storing the response.

TestWriter also simplifies the process of troubleshooting defective units. The operator makes selections from menus, aided by prompts and graphic displays. The personal computer automatically sends the appropriate commands to the 9020A and records the responses. It also provides a graphic display of the node that the operator is probing, along with the other points that drive that node.

As each nodal measurement is taken, the display will show whether the response was GOOD or BAD. The software will continue to ask for probe points until it can make a decision on the cause of the problem. Once made, this decision is displayed on the CRT.

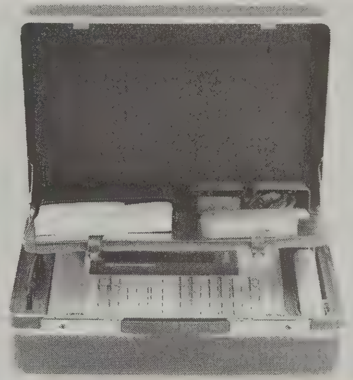
For cases where the operator is experienced in troubleshooting a particular board, TestWriter also allows unguided fault isolation, in which the operator decides the order in which nodes are to be tested.

Pod Adapter Packaging Kit

Allows testing of many microprocessor systems not directly supported by a Fluke interface pod. Consists of all the parts necessary to house the adapter circuitry, to connect the pod to the adapter, and to connect the adapter to the UUT.

Transit Cases

Lockable hard case holds 9000 Series pod, probe, accessories, four mini-cassette tapes, and user's manual. Foam-lined, sturdy construction.



Specifications

Display: Vacuum fluorescent; displays up to thirty-two 14-segment alphanumeric characters at once.
Self Test: All 9000 Series units perform self-tests at each power-up, verifying proper operation of internal RAM, ROM, clock, power supply, display, and communications with interface pod. Pod has own self-test socket to verify proper operation at microprocessor plug.
Test Speed: Tests run at full system speed, based on clock in unit under test.
Keyboard Data Entry: Hexadecimal — 0 through 9 and A through F.
Mag Tape: (9005A and 9010A only). Minicassette tapes store all "learned" data plus test programs generated on-line for off-the-bus testing. One tape holds up to 12K bytes — the same as internal memory on the 9005A and 9010A. Both units come with a built-in tape drive.
Interface Pod: Plugs into 9000 Series mainframe; must match type of microprocessor used in circuits being tested. Pods available for 8-bit and 16-bit microprocessors. Special circuitry protects pods from damage even if plugged in backwards.
Troubleshooting Probe: Plugs into 9000 Series mainframe. In response mode, takes signatures, counts events, shows logic states; in stimulus mode, injects either clock-synchronized or 1 kHz pulses. Measurement thresholds are 0.8V (low), 2.4V (high). Stimulus pulses are <0.2V at 100 mA (low), >4V at 100 mA (high). Probe is protected to ±30V.

Automatic Functions Summary

Learn Mode: (9010A only). Uses a known-good system of same type as unit under test to locate and determine size of RAM, ROM, and read/writeable I/O registers, and to compute signatures. Stores results in memory for immediate comparison to circuits being tested; data can also be saved on minicassette — or (with RS-232C option) downloaded to another system or device.
Built-In Kernel Tests: Using data entered either automatically through Learn mode or manually through the keyboard, the 9000 Series Troubleshooters will perform the following tests of kernel circuitry (each initiated by a single keystroke):

- BUS — Checks electrical integrity of address, data, and control lines; isolates stuck nodes and adjacent-trace shorts.
- RAM SHORT — Checks each RAM location for ability to read and write; verifies address decoding; detects data-line shorts beyond bus buffers.

- ROM — Computes ROM signatures and compares them with those in the known-good unit.
- I/O — Checks each I/O register identified in the known-good system to make sure it is read/writeable.
- AUTO — Runs all the above tests; initiated by a single keystroke. (Typically requires several minutes, depending on size of memory being checked.)
- RAM LONG — A more complex RAM test, used to isolate "soft" or pattern-sensitive RAM faults.

In addition, 9000 Series Troubleshooters continually monitor the power supply of the unit under test for out-of-tolerance conditions, and interface pods display an error message if they detect a bad clock signal.

Troubleshooting Functions Summary

The following function keys are available on the 9000 Series Micro-System Troubleshooters:

- READ — Displays data contents of specified address.
- WRITE — Writes specified data to any address location.
- WALK — Writes automatic walking pattern to specified address.
- RAMP — Writes automatic binary incrementing ramp to specified location.
- TOGGL DATA — Pulses specified data bit between high and low state.
- TOGGL ADDR — Pulses specified address bit between high and low state.
- TOGGL DATA, then STS/CTL — Pulses specified control bit between high and low state.
- READ PROBE — Displays probe measurements, including signatures, logic states, and event counts.
- SYNC — Allows probe measurements or stimulus to be either asynchronous or synched to valid address or data periods on the microprocessor bus.
- HIGH (Pulse) — Activates high-going pulses. The frequency and width of the pulses depend on the sync mode selected.
- LOW (Pulse) — Activates low-going pulses. The frequency and width of the pulses depend on the sync mode selected.
- HIGH and LOW toggle — Pulses alternate between high-going and low-going.

Also, a scope trigger-signal of about 100 mV amplitude can be synchronized with address or data sync pulses from the mainframe.

Test-Programming Functions Summary (9010A)

(Not applicable to 9020A; available in execute-only mode on 9005A.)

Users wishing to troubleshoot beyond the system kernel into peripheral devices can write and edit test programs tailored to the unique architecture of the systems they work with. The following keys are available for on-line programming:

- PROGM — Opens and closes test programs (both for development and for editing).
- EXEC — Runs selected test program.
- DISPL — Allows programs to include operator prompts (e.g., PROBE U6 PIN 7).
- Sequencing keys (IF, >, =GOTO, LABEL) — Available for comparison, branching, looping, and labeling steps in the test program.
- Arithmetic keys — Eight logical operations available for arithmetic control of mainframe registers that store user-specified address and data information during program writing.
- Editing keys — Allow the operator to scroll backwards or forwards through the programming steps.

Mode Control Summary

Mode control keys give operator control over all functions: automatic tests, programmed tests, and troubleshooting operations. The following mode control keys are available:

- STOP — Halts current test or operation.
- RPEAT — Causes test or operation to repeat once.
- CONT — Advances to next test step or continues last operation.
- LOOP — Continuously repeats a functional test, programmed test step, or troubleshooting command — or loops on any fault.
- RUN UUT — Allows full exercise of both the self-diagnostics and normal run operation of the unit under test, with the pod microprocessor acting as the processor of the unit being tested.

General Specifications

Temperature: 0°C to +50°C operating temperature (+10°C to +40°C for minicassette); -40°C to +70°C nonoperating temperature (+4°C to +50°C for minicassette)
Power: 100, 120, 220, 240V ac ±10%; 50 Hz, 60 Hz ±5%; 40W maximum
Size: 11.5 cm H x 35.5 cm W x 30.5 cm D (4.5 in H x 14 in W x 12 in D)
Weight: 6 kg (11 lb) mainframe; 0.7 kg (1.5 lb) per interface pod
Included With Purchase of 9000 Series Troubleshooter: Probe, probe accessories, two minicassettes (none with 9020A), manuals, power cord

Models

	January 1986 prices
9005A Micro-System Troubleshooter	$2995
9010A Micro-System Troubleshooter	4390
9020A-001 Micro-System Troubleshooter w/RS-232C Interface	4990
9020A-002 Micro-System Troubleshooter w/IEEE-488 Interface	4990

Options

9010A-001* RS-232C Interface for 9010A or 9005A	450
9010A-910 Utility Tape for 9010A	95
9010A-920 Language Compiler compatible w/Fluke 1720A and 1722A Instrument Controllers	495
9010A-922 Language Compiler compatible w/Kay Pro® II	495
9010A-923 Language Compiler compatible w/IBM Personal Computer	495
9000A-006* Asynchronous Signature Probe Option	995
9000A-950 TECHPRO PC TESTER Software	1500
9020A-925 TestWriter Software	2500

**Not customer-installable*

Interface Pods

9000A-Z80	1090
9000A-Z80/AA	1295
9000A-Z8000**	1995
9000A-1802**	1595
9000A-6502	1090
9000A-6800	1090
9000A-6802**	1090
9000A-6809**	1490
9000A-8048**	1995
9000A-8051**	1995
9000A-8080	1090
9000A-8085	1090
9000A-8086	2495
9000A-8088	1995
9000A-9900	1995
9000A-68000**	1995
9000A-80186	2695
9000A-80188	2695

***Each of these pods supports a family of microprocessors. See page 215 for a complete listing*

Accessories (Also see page 230)

9000A-200 Pod Adapter Packaging Kit	195
9000A-900 Transit Case	295
Y8007 Ten-Pack of Minicassettes	150

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

3200B

3200B Manufacturing Defects Analyzer

- High-speed testing of bare and loaded boards, backplanes, cables, and harnesses
- Industry leading measurement accuracy and ranges
- 65,536 possible test points
- Multisite testing for greater throughput
- Pin-verification testing
- Semiconductor junction testing
- Resistance measurements for resistor values and component-orientation testing
- Autolearn software for ease of use
- Smart assign/locate probe
- Verification program for system diagnostics
- Menu-driven software for easy file generation
- RS-232C interface for up/down loading to CAD and other external computer systems
- Available fixturing gives complete systems

In electronics manufacturing, the earlier you find a fault, the more time and money you save. Fluke's 3200B Manufacturing Defects Analyzer increases the efficiency of your production line by accurately identifying up to 80%* of all possible board defects at the earliest possible point in the manufacturing process.

With the 3200B, you can screen out simple shorts and opens on bare boards, before they leave receiving inspection. On loaded boards, the 3200B lets you find and repair shorted, missing, incorrect, inverted, or dead components, as well as open or shorted traces, at speeds far exceeding those of functional and in-circuit test systems.

Our proprietary Ratiometric Measurement Technique and Dual Threshold Autolearn combine to give the 3200B resolution, fault coverage, and fault classification second to none.

With its high fault coverage, low cost, and rapid test speeds, the 3200B is ideally suited for testing boards early in the manufacturing process.

Easy and Versatile

Autolearn Software. The 3200B's Autolearn software gives new meaning to the term "user-friendly," making system operation so easy that most users can begin testing the first day. This software lets you create a test program automatically for any application by using a known-good unit as a reference.

**Industry average*

BOARD TESTERS & TROUBLESHOOTERS

3200B/3218

Assign/Locate Probe. The 3200B comes with a smart probe that makes it easy to assign schematic designations or your own nomenclature to specific test points, so you don't need to refer to a cross-reference table to interpret fault reports. In locate mode, the probe is also a valuable tool for debugging programs or test fixtures.

High Pin Count. Fluke's proprietary scan chip lets the 3200B test more than 65,000 pins, far exceeding the test requirements of any board available today. This high-performance capability protects you against early obsolescence, as well as supporting multiple test sites. ,

Pin Verification. Before loaded-board testing, the 3200B performs pin-verification checks to make sure that test fixture pins are actually in contact with the board being tested. This procedure ensures the validity of later test results.

Semiconductor Junction Testing. The 3200B verifies both the presence and the orientation of each junction element, checking to see that the component is correctly mounted and functioning properly. Components checked include diodes, transistors, and integrated circuits.

Measurement Commands. The 3200B also includes a set of resistance, capacitance, and inductance measurement commands to test for specific values between points where reactive or resistive components exist.

Multi-Site Testing. As your test demands increase, computer power already resident in the 3200B lets you add expansion cards to the system, tying a second, third, or fourth test site to the mainframe. This is a cost-effective way to expand your testing capabilities: you can add an extra station for a fraction of what you'd pay to add a new tester. With the flexibility of the 3200B, you can either use the same test program at multiple sites or have each site specialize in testing a different type of equipment — for example, testing bare boards at one site and loaded boards at another.

Remote Operator Console. Each test station is equipped with a Remote Operator Console. Operators enter the test program numbers, their own identification, and the date; prompts walk them through the remaining steps. A key lock on the Console prevents unauthorized modification of existing test programs.

Communications Interface. The system's RS-232C interface speeds test programming on new PCBs, letting you download test files from CAD equipment or transfer nomenclature lists from an external computer.

Off-Line Programming. The 3200B includes an off-line programming station, allowing you to develop and edit test programs at the same time as you are testing. The programming station consists of a video display, keyboard, and microcomputer with dual floppy disk drives.

System Self-Tests. You can also use the system's off-line diagnostics at any time to check the status of the test processor, measurement, and scan electronics.

Options. Options available with the 3200B include:

- A 132-column, high-speed impact printer to augment the system's built-in 35-column printer; useful for printing program listings and expanded fault reports.
- A foot switch for foot control over "Start" and "Continue" commands.
- Measure command software, to test for specific values between ponts where reactive or resistive components exist.
- Expansion cards for distributing test capabilities at multiple sites. You can test loaded boards at up to two sites, and perform any combination of bareboard or backplane testing at up to four sites.

3218 Test Fixturing System

- High point count
- Vacuum-actuated receiver
- Wireless connections between receiver test points and scan cards
- Linear motion bearings for reliable contact with UUT
- Efficient sealing system
- Precision-mated spring probes
- Easy to service and maintain
- Economical
- Test fixtures fully customized or in kit form

The 3218 Test Fixturing System, designed for use with the 3200B Manufacturing Defects Analyzer, offers an accurate, reliable, and economical solution for testing circuit boards. It consists of two parts: a receiver and a test fixture.

Vacuum Receiver Offers High Point Count

The 3218 receiver is designed for versatility, reliability, long life, and ease of maintenance. It offers a high point count, with the ability to handle wiring configurations of up to 4096 points. The connection between receiver test points and scan cards is wireless, with pin receptacles mated directly to the scan card connector. This design reduces stray capacitance and makes tests less susceptible to electrical noise interference. Linear motion bearings ensure precise alignment between the receiver and the test fixture, while the hinged construction of the unit allows easy access for maintenance.

Test Fixture Ensures Precise Alignment

Test fixturing is available in kit form or fully customized by Fluke.

The 3218 test fixture is a precision device, designed to give you consistent, accurate test results. Both the top plate and base plate use quad linear motion bearings, ensuring precise alignment and reliable contact with the unit under test every time vacuum is applied. The fixture's small vacuum evacuation area is equipped with a highly efficient sealing system, eliminating the risk of dust and dirt contamination between the unit under test and the test fixture pins.

The thermoplastic injection-molded construction of the test fixture makes it lightweight and easy to handle. Servicing the unit is also simple: you can assemble or disassemble it in minutes. All components are accessible, both for making engineering changes to accommodate design revisions and for debugging the unit under test — even when vacuum is being applied. And the fixture's snap-latch opening and hinged construction provide easy access to wiring, probes, receptacles, and the receiver/test fixture interface.

Precision-Mated Spring Probes

Fluke offers a full line of quality spring probes to use with your 3218 test fixture. These precision-mated parts result in smooth traveling probes at either extreme of operation. A roll-crimped probe receptacle provides a gas- and air-tight connection that holds up to production-testing demands. Probes are available in a variety of styles, in both 4-oz. and 8-oz. spring force.

3218

Specifications

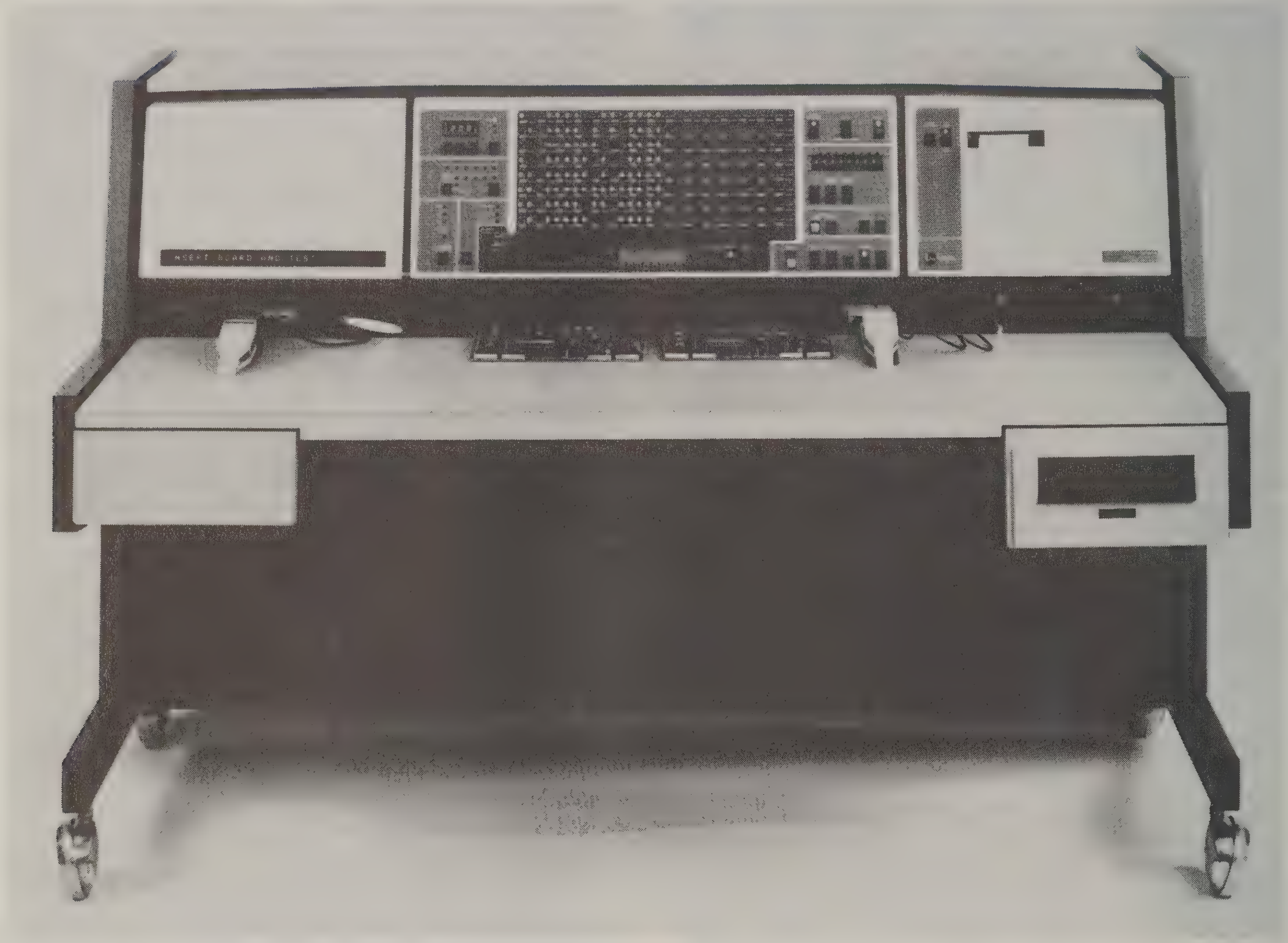
Test Points: Maximum of 65,536 for each 3200B system; individual switchboard has 128 points
Interface Cabling: Daisy-chained; one cable for each 2048 test-point array
Dual Continuity Thresholds: Loaded boards — short, 10Ω-10 kΩ, programmable; open, 1 kΩ-10 kΩ, programmable. Bare boards, backplanes —short, 10Ω-10 kΩ, programmable; open, 1 kΩ-100 kΩ, programmable
Test Stimulus Voltage for Continuity: Loaded boards, 300 mV; bare boards, backplanes, and cables, 8V
Junction Tests: Two-point programmable tests from 250 mV to 8V, with tolerance range, for diodes, transistors, and ICs
Test Statistics: Reports quantity of units tested, and quantity and percent that passed
Programming: Autolearn Software lets 3200B automatically learn continuity patterns from known-good unit; manual program entry available at off-line programming station; can download programs from CAD systems and other external computer systems
Program Storage: Dual 8-inch, double-sided, double-density disk drives; 1.25 MB storage per drive
Assign/Locate Probe: Single-point probe for convenient assignment of user-defined nomenclature
RAM: 512K standard expandable to 1 megabyte
CRT Terminal: 14", 80 columns x 24 lines, upper/lower case ASCII characters, 7 x 9 character font
Test Sites: On one 3200B, up to two test sites for testing loaded boards; up to four for testing any combination of bare boards, backplanes, and harnesses
Remote Operator Console: One per test site. Includes:
  Display: Four-digit LCD for numeric data entered from key pad
  Controls: Learn, bare board, loaded board, backplane. Set dual HI/LO threshold limits, operator ID number, day/month, test/continue, job number, print first fail, print statistics, clear statistics, print program listing, enter data, save auto-learn data file on UUT, reset, abort, paper advance
  Indicators: Test, reset, halt, power on/off, pass/fail
  Printer: 35-column impact printer, 60 cps, upper/lower case ASCII characters
  Keylock: Protects test programs from unauthorized modification
  I/O: External input connection for installing foot switch or assign/locate probe; external RS-232C port
Communications Port: External RS-232C port for up/down loading from CAD and other external computer systems. Maximum baud rate, 9600; asynchronous
132-Column Printer (optional): Model 3058A Impact Printer; 160 cps

General Specification

Temperature: +10°C to +38°C
Power: 500W
Size: 58 in H x 72 in W x 32 in D
Weight: 850 lb

BOARD TESTERS & TROUBLESHOOTERS

3050B



3050B

3050B Digital/Analog Functional Test System

- Reference board testing for flexible, low-cost functional testing
- Single-board test using signature-based diagnostics
- Automatic diagnostic software
- Test management system
- Automatic fault emulation
- Analog comparison for testing analog waveforms
- Analog test station with IEEE-488 port for comprehensive testing of analog boards
- Off-line programming station
- 1780A InfoTouch® Display
- Built-in 35-column printer

Locating functional board failures before they become system failures is the surest route to high production yields — but with price tags of half a million dollars or more, functional testers have typically been out of reach of most production operations. The Fluke 3050B Digital/Analog Functional Test System is the answer, offering comprehensive functional testing at confidence levels of 98% or higher, for an initial investment as low as $100,000.

The 3050B performs comprehensive functional testing, detecting difficult-to-locate dynamic faults that appear only when a board is running at rated speed. It can handle your toughest functional testing challenges, from hybrid circuitry to complex boards with surface-mounted devices —and its versatility makes it useful for rework and repair applications, as well. With the 3050B, you'll experience higher throughput, fewer defective boards at the system-test level, and a lower level of work-in-process.

Reference Board Test Procedures

The 3050B is much less expensive than most functional testers because its test procedures are based on a different technology. Instead of simulating the performance of the unit under test, which can require an enormous software library, the 3050B compares a known-good reference board to the unit under test. This approach not only costs less but offers far greater speed and accuracy. It also makes it much easier to keep your test procedures current as design changes are made in hardware and firmware: in many cases, you can accommodate these changes simply by changing the reference board.

Single Board Test

For applications that involve testing a wide variety of boards, the 3050B's Single Board Test capability eliminates the need to maintain a large inventory of reference boards.

Instead, a composite signature from a known-good unit, representing the total of all the board-edge pins, is stored on disk — as are group, subgroup, and node signatures. The 3050B then uses a signature-based diagnostic program to locate the fault by comparing signatures from the defective unit with those stored on disk.

In applying this technique, the operator first uses the 3050B to take a composite signature from all board-edge pins. The 3050B compares the results with the composite signature stored on disk. A faulty bit stream on any board edge pin results in a faulty signature, and therefore a failed test. Next, the 3050B prompts the operator through the process of testing first group signatures, then subgroup signatures, and finally node signatures, until the faulty node is located.

High-Speed Pass/Fail Testing

In your main production line, the 3050B provides you with high-speed pass/fail board testing, checking an entire board in ten seconds or less. The operator can execute simple commands (TEST, START, YES, etc.) at the touch of a front-panel switch — or with the convenient foot control. Prompts guide the operator through the test process, and pass/fail lights indicate the results. In addition, the 3050B will log all failures as they occur, giving you printed reports with detailed statistical information.

Automatic Diagnostic Software

The 3050B's Automatic Diagnostic Software package makes this versatile tester useful for rework and repair applications as well as for production-line functional testing. This software lets you quickly and accurately isolate faults — often in a matter of minutes.

The Automatic Diagnostic Software offers state-of-the-art, high-resolution board diagnostics, capable of handling anything from simple SSI logic to a multiplexed microprocessor bus. It provides completely automated troubleshooting of all digital circuitry — unidirectional, bidirectional, and loops — leapfrogging from the board edge for added speed. With the 3050B's Automatic Diagnostic Software, you can successfully troubleshoot such difficult problems as unstable symptoms, initialization failures, and speed-related faults. And, with the addition of the analog option, the interface between this software and the 3050B's Test Management System lets you perform analog diagnostics, as well.

Custom Control of Testing

The 3050B's Test Management System gives you custom control of test and diagnostic routines. In addition to automatically setting up your tests and loading the necessary test programs, this software lets you dynamically alter both test program flow and test frequency, so you can develop custom procedures for special situations. The Test Management System controls analog testing, as well. And its data logging capabilities let you automatically record and print failure data.

The Test Management System language combines high-level language instructions (similar to those found in BASIC, FORTRAN, and Pascal) with instructions unique to the 3050B. These instructions interrogate and control the 3050B before, during, and after testing. The language structure is such that Test Management System programs can be incorporated into normal tester programs, such as Autotrack. The Test Management System also includes macro libraries, so test engineers can define macros for system use, as well as an adaptation of the ATLAS language for communicating with the 3053B Analog Instrumentation Module.

Analog Testing

With the analog option, you can use the 3050B to test analog waveforms as well as digital circuitry. In analog testing, the 3050B uses program-defined voltage tolerances to check for waveform differences between the reference board and the unit under test. It can detect errors relating to gain, phase, and shape. For additional analog test capability, add the 3053B Analog Instrumentation Module. The 3053B comes with a rack of IEEE-488-compatible test instruments, including an ICS 4885 Controller, a Fluke 1953A Counter/Timer, a Fluke 8520A Digital Multimeter, two Lambda programmable dc power supplies, a Wavetek 275 Programmable Function Generator, and a Racal Dana 1200 Switch Matrix. All instruments are programmed with an adaptation of ATLAS, a powerful language that uses English-like statements. An RS-232C-to-IEEE-488-converter (ICS 4885) lets this test instrumentation communicate with the 3050B.

Using the 3053B, ATLAS, and the 3050B's Test Management System, you can create semi-automated analog diagnostics, measuring voltages of ±50V and frequencies of up to 10 MHz. The combination of the 3050B and the 3053B gives you confidence levels of 98% or higher in testing hybrid boards, letting you isolate both digital and analog faults to the component level.

Powerful Processing

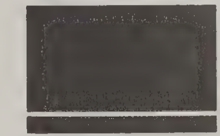
The multiple processors of the 3050B give it powerful processing capabilities. In addition to its 16-bit Control Microprocessor, providing overall system control, the 3050B includes an Auto Sequence Processor, for real-time generation of nine classes of automatic patterns, and a Stored Sequence Processor, for implementing user-defined test sequences.

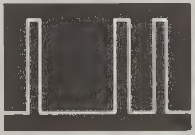
Automatic Fault Emulation

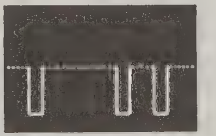
The 3050B includes an Automatic Fault Emulator to give you complete control over the quality of your test programs. The Automatic Fault Emulator is both quicker and more accurate than hypothetically generated fault simulation: It can verify a test program for a 100 IC board in about four hours, as opposed to simulator-based systems, which can require nearly a week.

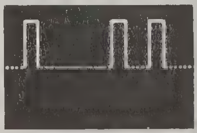
Using one of five different classes of faults (see Figure 2), the 3050B empirically tests the comprehensiveness of your test program. It emulates hard and soft failures, calculates both stimulus and fault coverage, and highlights the circuit areas needing test improvement. For a more complete analysis, it will even give you a hard-copy printout of the test results.

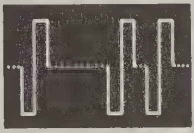
Fault Types:


Stuck Low


High-Low


Intermittent Low


Intermittent High


Intermittent High Low

Off-Line Programming

For fast and efficient generation of test and diagnostic programs, add the 3051B Off-Line Programming Station. This system makes program development easy, with user-oriented software, macro commands, and prompts to guide the test engineer through the entry process.

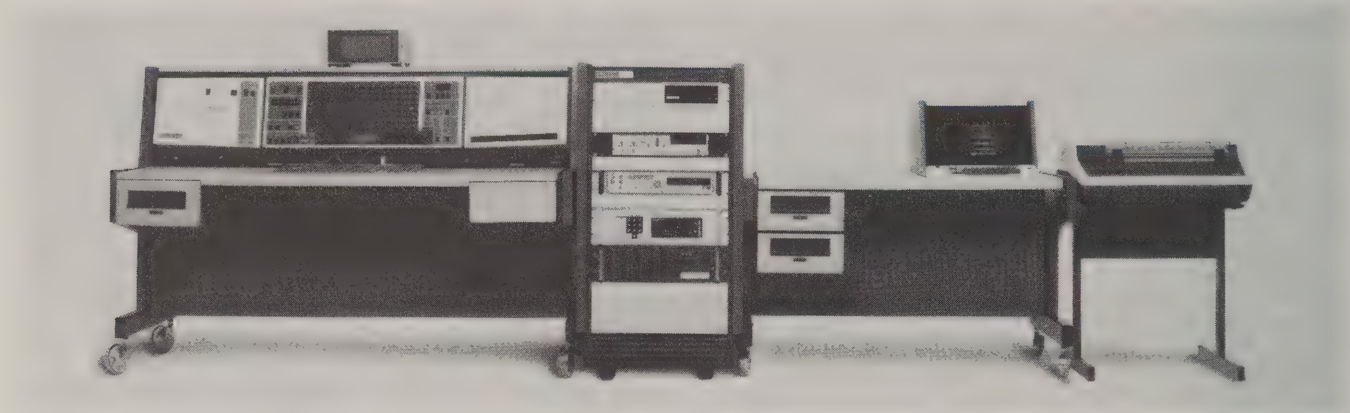
The 3051B includes an RS-232C communications interface to let you transfer data to and from external computer systems, as well as to the 3050B. Dual, double-sided floppy disk drives provide abundant storage —or you can link the station to a host computer for centralized program management.

Touch Display

For greater operator convenience, add the 1780A Touch Display to your 3050B. With the Touch Display, the operator can make selections, perform test procedures, and enter data logging information (such as the serial number of the unit being tested) without a keyboard, simply by touching the display. (For more information on the Touch Display, see page 202.)

BOARD TESTERS & TROUBLESHOOTERS

3050B/3040A-1

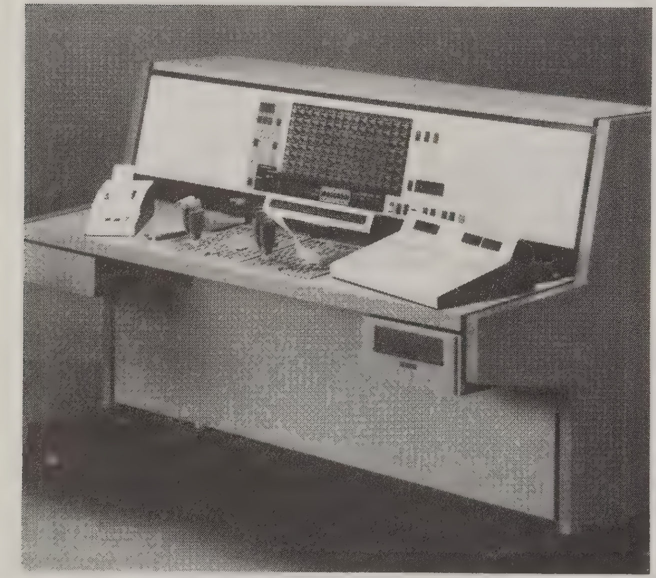


Printer
Fast RS-232-compatible printer for permanent program documentation

3051B
Offline Programming Station with two floppy disk drive units, keyboard, and terminal. System's prompting editors guide test engineer

3053B
Test station of analog stimulus and measurement instruments. RS-232 and IEEE-488 interfaces. Programming uses adapted ATLAS language

3050B
Test console with clips and probes for both reference board and board under test. Reference board eliminates need for large memory, time-consuming IC modeling. A 35-column printer provides hard copy of test analysis



3040A-1

The 3040A-1 Digital/Analog Test System minimizes the cost and time required for functional-test programming by using reference-board procedures. That is, it derives the correct response for each node of the unit under test from a known-good board instead requiring the test engineer to input these values.

For testing of single units, the 3040A-1 offers single-board testing, generating a composite signature from all the board-edge pins. This signature is compared with the composite signature from a known-good board, stored on disk. A faulty bit stream on any board-edge pin results in a faulty signature — and therefore a failed test.

The 3040A-1 also can verify the comprehensiveness of user-generated test programs with its Automatic Fault Emulator. This software specifies the percentage of faults that a particular program can detect.

Stored and Automatic Sequence Programming

Stored sequences are user-defined patterns specifying output data or ranges of I/O channels. These give the 3040A-1 control over the functions of the unit under test. Automatic sequences are pseudo-random, gray-encoded automatic patterns of clocks, pulses, and data, used by the 3040A-1 to exercise the functions of the unit being tested. By using a combination of stored and automatic sequences, the 3040A-1 speeds the programming process while ensuring thorough testing of all board functions.

Optional Multimode Diagnostics and Analog Testing

The 3040A-1's optional clip and probe algorithms, with prompts to guide the operator, are useful for tracking defects and breaking loops — even under dynamic conditions. The system's printer lists the tracking sequence and diagnostic statements as well as identifying the defective node.

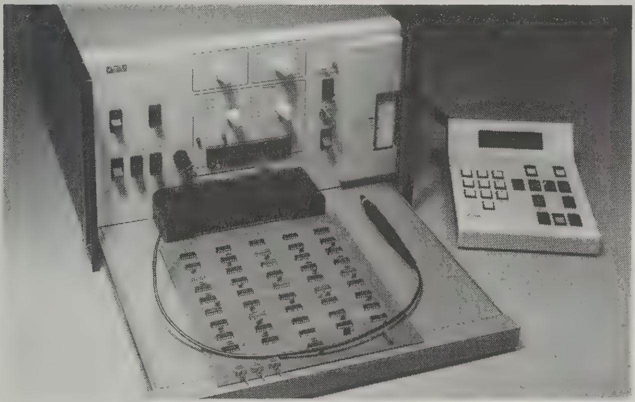
The 3040A-1 also includes an analog option, Complex Waveform Conformance, providing up to 32 channels of analog testing capability. With this option, you can test analog and digital signals on the same board at the same time.

3040A-1 Digital/Analog Test System

- Reference board testing
- Single-board tests
- Stored and automatic sequence programming
- Automatic fault emulator
- Multimode diagnostics
- Analog testing
- Off-line programming station

Off-Line Programming

The 3041A-1 off-line programming station lets you generate test programs without interrupting test activity. Prompts guide the test engineer through each step of the process. The programming station includes a full ASCII keyboard, CRT display, dual floppy disk drives, and an RS-232C printer interface for program documentation.



3010A

3010A Logictester

- Portable benchtop tester
- Simplified programming
- High-speed testing
- Walk-back diagnostics

The 3010A Logictester is a self-contained portable unit useful for functional testing of moderately complex printed circuit boards. It simplifies programming by algorithmically generating a large array of stimulus patterns. As a result, you can develop test programs in hours instead of weeks, by simply selecting the appropriate stimulus algorithm for each input. The 3010A further simplifies programming by eliminating the need for assemblers, compilers, and tapes, letting you both program and edit on-line.

High-Speed Testing

With the 3010A, you can perform high-speed testing at rates up to 4 MHz, as well as one-shot and continuous pulse-width measurement. For one-pass, go/no go tests, the 3010A includes an output count integrator that logically combines the activity of all I/O pins into a single signature.

Rapid Fault Tracking

The 3010A allows quick isolation of faulty nodes. It checks the nodal signatures of 8-pin subgroups until it finds an incorrect count. The operator then backtracks through the nodal transition counts to the point where inputs to an IC are normal but outputs are incorrect. This is the defective node.

After-Warranty Service (See page 227)

A full range of service and support agreements is available for this product. See page 227 for instructions on obtaining prices for Fluke maintenance, calibration, training, and consulting programs.

Glossary of Terms

Adjacent trace short — A short resulting from an inadvertent connection between two adjacent traces.

Assign/locate probe — A "smart" probe used with the 3200B. Lets users assign their own nomenclature to test points; also helpful in debugging programs and test fixtures.

ATE — Automated test equipment, including systems such as manufacturing defects analyzers, functional testers, and incircuit testers.

ATLAS — A powerful programming language for analog applications. Uses English-like statements.

Auto-learn — 3200B automatic self-learn operation that finds continuity and isolation patterns from a known-good board or backplane.

Backplane — Unit of electronic equipment in which various logic and control elements are interconnected. Often takes the form of a "rat's nest" of wires, interconnecting printed circuit cards in the rear of computer racks or cabinets.

Bare board — A printed circuit board with no components on it — just traces.

Bed-of-nails test fixture — A surface on which spring pins are strategically located so as to make electrical contact with a UUT.

CAD — Computer-aided design.

Card cage — A metal rack that provides housing and interconnection between printed circuit boards.

Confidence level — A statistical percentage indicating the likelihood of successfully isolating all faults.

Continuity — A resistance between two points that is less than the programmed low threshold; means the points are shorted together.

Cps — Characters per second; unit of measurement for printer speed.

Dynamic faults — Faults that appear only when the components on the board are interacting in sequence, at rated speed.

Functional test — A test for faults that only appear when the components on the board are interacting in sequence, at rated speed. (Also see Dynamic faults.)

Hybrid board — A printed circuit board including analog as well as digital components.

IC — An integrated circuit.

IEEE 488 — A high-speed communications interface, often used in analog test equipment.

Interface pod — A microprocessor-specific unit used in connection with Fluke board test equipment, giving it the ability to emulate the activity of the microprocessor on the board.

Isolation — A resistance between two points that is greater than the programmed high threshold.

Junction test — Verifies the presence and orientation for a junction element, checking to see that the component is correctly mounted and properly functioning. Used to check diodes, transistors, and, in many cases, ICs.

Kernel — The central circuitry on a microprocessor-based board, including the microprocessor, bus, RAM, ROM, and I/O circuitry.

LEARN algorithm — See **Auto-learn.**

Loaded board — A printed circuit board with all components inserted.

Measure command software — A group of commands that tests for specific values between points where reactive or resistive components exist.

Minicassette — A storage medium used by Fluke board test equipment for storing test programs.

Node — A terminal of any branch of a network, or a terminal common to two or more branches on a printed circuit board. Also called a junction point, branch point, or vertex.

Out-of-tolerance component — One which, when tested, is not within its specified tolerance rating.

PCB — A printed circuit board.

Peripheral circuitry — On a microprocessor-based board, circuitry located outside the kernel. (Also see **Kernel**.)

Pin verification — A preliminary test to make sure all tester pins are in contact with the UUT before the actual test begins. This feature is designed to be used with loaded-board tests. It is based on the assumption that, from any given point on a loaded board, there is a path to either Vcc or ground.

Prompt — A displayed message that guides the operator to the next step.

RAM — Random access memory.

Resistive pin — A point that has an impedance value that is lower than the high threshold and higher than the low threshold.

Response — Electrical output produced by a node when it is stimulated. (Also see **Stimulus voltage**.)

Rework — Repair of defective boards that takes place as part of the production operation, allowing malfunctioning boards to be recycled instead of discarded.

ROM — Read-only memory.

RS-232C — A standard communications interface specifying various electrical and mechanical characteristics for a bit-serial interface between computers, terminals, and modems. It describes an interface consisting of 25 pins or leads, each of which is lettered and provides a function, such as timing control or the sending of data.

Semiconductor junction test — See **Junction test.**

Short — Continuity where isolation is expected.

Signature — Four bit hex number representing data stream at a node.

Stimulus voltage — A voltage applied to the UUT during a measurement. In shorts and opens testing, the stimulus voltage is fixed at 300 mV in loaded-board mode and 8V in bare-board, backplane, or cable testing. For measurement commands, it is programmable from 300 mV to 8V. For junction tests, it is fixed at 2V.

Test site — A workstation for testing boards, consisting of a remote operator console and a user-defined test fixture. This workstation provides the interface to the test station processor.

Troubleshooting — Locating and diagnosing faults or malfunctions in electronic equipment by means of systematic checking or analysis.

UUT — The unit under test.

To Put Fluke Board Testers and Troubleshooters to Work for You. . .

Any of the Fluke Sales Offices or Representatives listed on page 243-245 can help you determine which combination of equipment best meets your board testing and troubleshooting needs. Additional assistance in developing an analysis and justification for board testing and troubleshooting is available in the following ways.

- **Attend a free Micro-System Troubleshooting Seminar.** Topics will include:
  - Use of built-in tests
  - Use of mode keys
  - Troubleshooting functions available
  - Probe use
  - Basic programming
  - Auxiliary interface

Contact your Fluke Sales Office or Representative for seminar dates and locations.

- **Request a Return on Investment Analysis** for the 3200B Manufacturing Defects Analyzer or the 3050B Functional Tester. Contact the Fluke Sales Office nearest you (see pages 243-245). Based on the variables of board testing requirements as well as economic variables such as labor rates, productivity, depreciation, and tax factors, the sales staff can develop an analysis stated in terms of Payback Period, Rate of Return, Net Present Value, Profitability Index, or whatever method you need for your application and management methods.

PRODUCT SUPPORT & SERVICES

Introduction

Your investment in Fluke equipment deserves the best possible protection. That's why we offer Fluke Support Services — a complete range of maintenance, training, and consulting options for Fluke products. Fluke Support Services are your insurance that the equipment you buy will perform accurately and productively for years to come.

Selection Guide

Support or Service	**U.S.A.**	**Other Countries**
Product Availability Product Specification Application Assistance Product Information Leasing Information	Your Sales Office (See page 243) or phone either **(800) 426-0361*** or **(206) 356-5400**	Your Fluke Representative (See page 244 or 246) WU Telex: 152385 TRT Telex: 185-103 **Phone (206) 356-5500**
Consultation Software Development Site Evaluation Installation Application Training	Your Sales Office (See page 243) **(800) 843-2773*** or **(206) 356-6330**	Your Fluke Representative (See page 246 or 247)
Repair/Calibration Training Repair/Calibration Service Repair/Calibration Assistance Service Agreements Module Exchange	Your Technical Center (See page 246) **(800) 843-2773*** or **(206) 356-6330**	Your Service Representative (See page 246)
Replacement Parts Instruction Manuals	John Fluke Mfg. Co., Inc. P.O. Box C9090 Everett, WA 98206 Attention: Parts Dept. M/S 86 or call **(800) 526-4731*** or **(206) 356-5774**	Your Service Representative (See page 246)

**Hours: 8 a.m. to 4:30 p.m. Pacific Time*

(800) 843-2773
For Support Services
Assistance
or
(800) 526-4731
For Replacement Parts
or
(800) 426-0361
For Product Information

Corporate Headquarters
John Fluke Mfg. Co., Inc.
P.O. Box C9090, Everett, WA 98206
(206) 347-6100

European Headquarters
Fluke (Holland) B.V.
P.O. Box 2269
5600 CG Eindhoven
The Netherlands
Tel: (40) 458045
TLX: (844) 51846

PRODUCT SUPPORT & SERVICES

Assistance and Consulting

- Applications assistance and consulting
- Hardware assistance and consulting
- Software assistance and consulting
- Site evaluation and installation consulting
- Third-party support and consulting

When Fluke electronic test and measurement equipment is used in a systems application the systems builder may wish to request additional support from the Fluke organization. This support could be as easy as a telephone call or as comprehensive as on-site consultation. The Applications Support Group can provide a full range of customer assistance and support for all Fluke hardware and applications.

Customer Training

- Maintenance training
- Applications training
- Product training
- Technology seminars
- Special customer training packages

Training is a key element in our Customer Support program, providing the essential transfer of knowledge necessary to insure successful utilization and maintenance of Fluke products.

The Training Group develops and implements both regularly scheduled and custom-tailored training courses to meet a wide range of customer needs. To discuss your special Training needs, or to obtain our 1986 Training Course schedules, please contact your nearest Fluke Sales office or International Representative.

Repair and Calibration Services

- 90-day warranty of complete unit
- Installation of product improvements
- Full N.B.S. traceable calibration and/or alignment
- Standard pricing for most models
- Documented quality assurance program
- Compliance with MIL-STD-45662 and nuclear industry standards
- Special calibration data available

Each Fluke Technical Center is equipped with the necessary instruments, standards, procedures, and personnel to maintain Fluke products at peak performance. The procedures and documentation comply with MIL-STD-45662 and Nuclear Regulatory Commission requirements, assuring accuracy traceable to the National Bureau of Standards. Proper use of measurement standards is carefully and continually monitored through a corporate Controlled Audit Program.

The Fluke Standard Price Program establishes a fixed charge for calibration and/or repair for each type of instrument. The price for calibration and/or repair includes all labor and material required.

These standard prices, which are based on historical averages for time and material, help you determine service costs in advance and avoid the potentially critical delay of quotation and approval procedures. Naturally, some units may have to be excluded from the program because of age or abuse. In such cases you will be advised and, if you approve, charged on the basis of the actual labor and parts required.

For more details and a current price list on the Standard Price Program, contact your nearest Fluke Sales Office or International Representative.

Service Agreements

- Fixed maintenance cost so you can budget accurately each year
- Prioritized service
- Shorter repair cycle
- Reduced parts inventory
- Lower maintenance training costs
- Less demand on your technical personnel and resources

Service agreements are a cost-effective way of maintaining your Fluke instruments at pre-determined costs.

The Fluke Customer Support Group offers three types of Service Agreements:

Standard Service Agreements — On Site. On-site Service Agreements on selected Fluke products are available which provide services conducted on your premises. These agreements normally cover a one year period, and include parts, labor, and travel costs. There are no inspection costs when purchased prior to warranty expiration or prior to renewal of a previous agreement.

On-site agreements offer priority attention, with a typical response time of 1 day or less. The cost for this agreement depends on the type of instrument or system, the distance to the nearest Fluke Technical Center, and whether the agreement period includes the product warranty period. For your convenience, monthly, quarterly or yearly payment intervals are available.

Standard Service Agreements — Technical Center. This Repair Service Agreement provides warranty-like support performed at your nearest Fluke Technical Center. The agreement provides labor, parts, recalibration and return surface transportation for all covered Fluke products which fail through normal use during the agreement period. Agreements can be purchased without pre-agreement inspection costs if the product is still under new product warranty, or within 90 days of out-of-warranty service performed by a Fluke Technical Center.

A discount is given if the Standard Service Agreement is purchased with the instrument, and will commence at the warranty expiration date. The annual cost of Standard Service Agreements for individual instruments is shown on the catalog page describing that instrument.

Calibration Service Agreements. Calibration Service Agreements are available to provide scheduled calibration services at intervals you specify. This agreement can be combined with a Repair Service Agreement to satisfy your complete maintenance needs. Prices vary with model and desired calibration interval. Your local Fluke Sales Office or International Representative can provide complete information on agreements of this type.

Custom Service Agreements. This service can be tailored to specific customer needs and requirements by contacting your local Fluke Sales Office or International Representative.

Replacement Parts

- Components that meet Fluke specifications standards
- Automatic notice of improved replacement types
- 90-day warranty
- Toll free parts order line (800) 526-4731*
- Recommended spare parts and module kits

Availability of replacement parts is a key element in providing quick turn-around and product support for customers who perform their own maintenance. By providing quality parts and responsive support, the Customer Support Group will help return your Fluke instrument to peak performance.

To support this service, an extensive inventory of repair parts is maintained by the Parts Department in Everett, Washington. From U.S. locations, you may place your orders directly to the Everett Parts Department by calling our toll-free number, (800) 526-4731 or (206) 356-5774. From locations outside the U.S., place your parts order with your nearest International Representative, who will expedite processing or fill your order from local inventory.

When ordering, please identify parts by the Fluke six-digit part number and description as shown in the instrument manual and, if possible, by the schematic diagram circuit reference number. The model number and serial number of the instrument will also help us supply the correct parts.

In some cases parts must be ordered in matched sets in order to maintain the specified accuracy and performance of the instrument after repair. Check the parts list and diagrams for footnotes containing special parts ordering instructions.

Recommended Spare Parts Lists or Spare Parts Kits are also available for most Fluke products.

Module Exchange Program

- Available for most modular products
- 24-hour delivery to most U.S. locations
- Minimum downtime for critical applications
- Reduced maintenance personnel training requirements
- Takes full advantage of product diagnostics
- 90-day warranty

Many Fluke instruments are modular in design and can be serviced most effectively by exchanging a defective module.

The Module Exchange Program allows you to obtain an exchange module quickly and economically. When using this program, you need only identify the defective module, which simplifies your troubleshooting procedures and reduces your training and skill requirements for maintenance personnel. Self-diagnostics built into many Fluke instruments further simplify the process of identifying the faulty module.

Once a defective module is identified, your local Fluke Technical Center (see page 246 for locations) will place your order with the Module Exchange Center located in Everett, Washington. The replacement module will be sent directly to you via overnight air carrier. A similar program is offered to customers in countries outside the U.S.

Please contact your Technical Center or International Representative for a list of Fluke products which are supported by the Module Exchange Program, and detailed information on exchanging defective modules.

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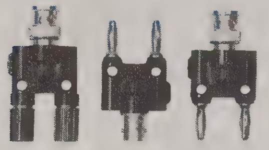
* *Hours: 6 a.m. to 4 p.m. Pacific time. Address: Parts Dept., M/S 86, John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, WA 98206*



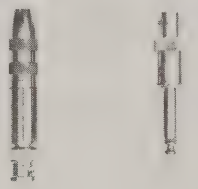
Y9109 Y9108 Y9113

BNC-Banana Adapters

BNC-to-banana adapters permit interconnection between equipment having BNC plugs or jacks and equipment with double banana plugs or jacks.*

**These adapters and exposed metal connectors should not be used for floating measurements that are greater than 30V ac, 42V peak or 60V dc above earth ground.*

Y9109 BNC Plug to Binding Posts
Y9108 BNC Jack to Double Banana Plugs
Y9113 BNC Plug to Double Banana Plugs



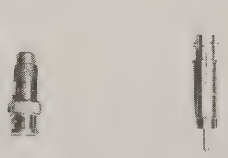
Y9115 Y9114

Phone Adapters

Adapters permit interconnection between equipment with phone plugs and equipment with BNC connectors.*

**These adapters and exposed metal connectors should not be used for floating measurements that are greater than 30V ac, 42V peak or 60V dc above earth ground.*

Y9115 BNC Plug to Phone Jack
Y9114 BNC Jack to Phone Plug



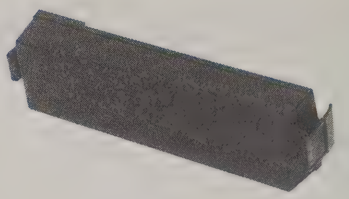
Y9117 Y9116

Phono Adapters

Adapters allow interconnection between equipment having phono connectors and BNC connectors.*

**These adapters and exposed metal connectors should not be used for floating measurements that are greater than 30V ac, 42V peak or 60V dc above earth ground.*

Y9117 Phono Jack to BNC Plug
Y9116 BNC Jack to Phono Plug

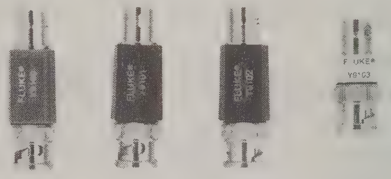


M00-100-714

M00-100-714 Panel Protectors

A front panel protector is a molded plastic, snap-on accessory which fits over the front panel of a DMM, counter, etc. The cover provides protection for the front panel controls, and is useful for storing or transporting the instrument.

M00-100-714 is designed to fit the 8000A and 8600A DMM, and the 1900A, 1910A, 1911A, 1912A Counters. M03-203-700 is designed to fit the 515A Calibrator and the discontinued 8200A DMM.



Y9100 Y9101 Y9102 Y9103

BNC 50-Ohm Attenuators, etc.

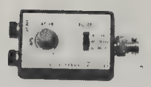
BNC 50-ohm, 2-watt attenuators for use with VHF and UHF instruments:

Y9100 6 dB Attenuator
Y9101 14 dB Attenuator
Y9102 20 dB Attenuator
Y9103 50-ohm feedthrough termination

Y9107 Y9110 Y9106

BNC Connectors

Y9107 BNC "T"
Y9110 BNC Jack for printed circuit boards
Y9106 BNC "T"



Y7201

A53

Y7201 Attenuator/Filter

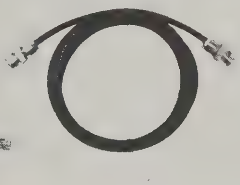
The Y7201 is a combination variable attenuator and selectable low pass filter which can be used for input signal conditioning on all Fluke counters.

Input Impedance: 47 kΩ
Attenuation Range: ÷5 to ÷100, continuously adjustable
Low Pass Filter: 1 kHz, 20 kHz, or 100 kHz switch-selectable
Maximum Input: 30V

A53 Telescopic Whip Antenna

Telescopic Whip Antenna connects to input of all counters. Uses swivel BNC connector. Permits measurements without direct cable connections whenever input signal strength is sufficient.

Y9112

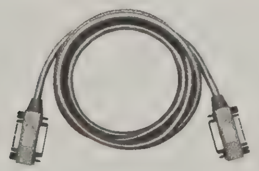


Y9111

50Ω BNC Coaxial Cables

RG-58 C/U coaxial cables with BNC connectors (plugs) on each end are available in two lengths:

Y9111 0.93m (3 ft), **Y9112** 1.85m (6 ft)*



Y8002

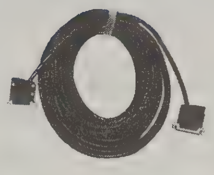
IEEE-488-Compatible Cables

A series of cables in three lengths are used to connect instruments to each other and to the IEEE-488 Bus. Each cable end has both a plug and a jack and are shielded.

Y8021 Shielded Cable, 1m (39.4 in)
Y8022 Shielded Cable, 2m (78.8 in)
Y8023 Shielded Cable, 4m (13 ft)

These adapters and exposed metal connectors should not be used for floating measurements that are greater than 30V ac, 42V peak or 60V dc above earth ground.

Y1709



Y1708

Y1707

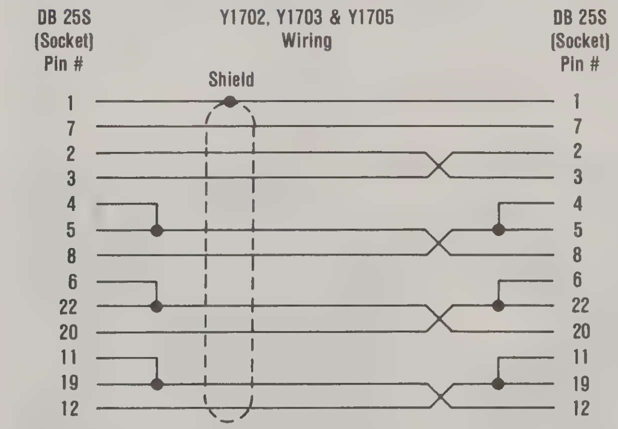
Y1705

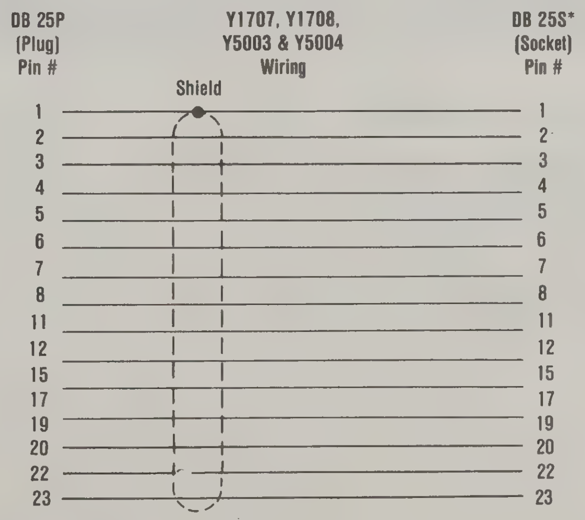
RS-232 Cables

These cables are to connect instrument controllers, terminas, modems, printers, etc. to other similar equipment compatible with EIA Standard RS-232-C.

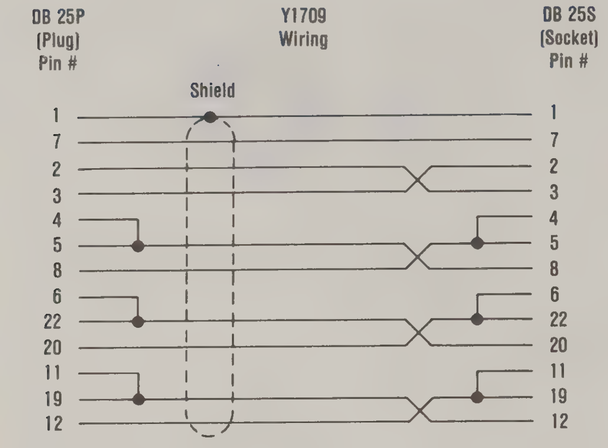
Y1702 2m (6.56 ft) Null Modem Cable
Y1703 4m (13 ft) Null Modem Cable
Y1705 30 cm (1 ft) Null Modem Cable
Y1707 2m (6.56 ft) Interface Cable
Y1708 10m (32.8 ft) Interface Cable
Y1709 1m (3.28 ft) Printer Cable
Y5003 1.52m (5 ft) Interface Cable
Y5004 3.05m (10 ft) Interface Cable

RS-232 Cable Wiring





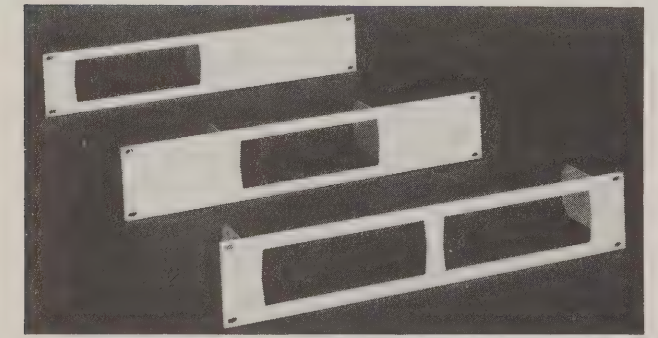
DB 25P for Y5003 and Y5004



Rack-Width Rack Adapters

Fluke bench/systems instruments are designed to be easily mounted in a standard 19-inch rack cabinet. Some have rack-mount panels and some need rack adapters. When adapters are required they are listed with the instrument — among its recommended accessories.

Portable Instrument Rack Adapters



Multimeter Rack Adapters, 3½″ High

8010A M00-200-611, M00-200-612, and M00-200-613
8000A, 8012A, 8050A, 8600A Same as for 8010A
8840A, 8842A Y8834, Y8835 and Y8836

Counter Rack Adapters, 3½″ High

1900A M00-200-611, M00-200-612, and M00-200-613
1910A, 1911A, 1912A Same as for 1900A

Thermometer Rack Adapters, 3½″ High

2165A M00-200-611, M00-200-612, and M00-200-613
2166A, 2168A, 2175A, 2176A Same as for 2165A

Panel-Mount Thermometer Adapters

2160A-7031

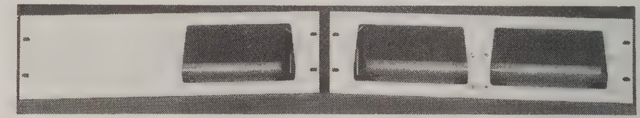
2160A-7032

2160A-7033

Either the 2160A or the 2170A Thermometer may be mounted in these rack-width panels that are 3½ inches high. Also, the 2161A Multipoint Selector and 2162A Digital Comparator will fit the panel openings.

PTI-Style Instrument Adapters

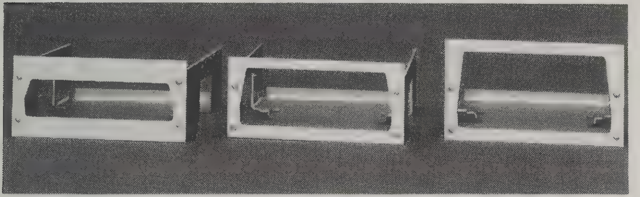
Rack adapters for the 2180- and 2190-Series Thermometers, 7200 Series Counters, 8920 Series DVMs, and other Fluke products in PTI cases look like those shown in the picture except for the size of the opening or height of the panel.



PTI Case Style	Panel Opening		Rack Panel Size	
	Single	Double	Height	Width
Style A	Y2010	Y2011	3½ in (89 mm)	19 in (483 mm)
Style B	Y2012	Y2013	5¼ in (133 mm)	
Style C	Y2014	Y2015		
Style D	Y2016	Y2017	7 in (177.8 mm)	
Style A + C	—	Y2027	5¼ in (133 mm)	

PTI-Style Instrument Panel Adapters

Fluke instruments in PTI-style cases may be mounted behind your own panel through a standard size panel opening by using one of the adapters identified below.



PTI Case Style	Adapter Number	Panel-Mount Adapters			
		Panel Cutout		Bezel Size	
		Height	Width	Height	Width
Style A	Y2018	92 mm (3.62 in)	186 mm (7.32 in)	97 mm (3.82 in)	214 mm (8.43 in)
Style B	Y2019	92 mm (3.62 in)		97 mm (3.82 in)	
Style C	Y2020	*		122 mm (4.80 in)	
Style D	Y2021	138 mm (5.43 in)		145 mm (5.70 in)	

* *Any dimension from 96mm to 116mm. Not Standard. Each kit fastens to a panel with four machine screws. The bezel fits over the front of the panel cutout and the screws hold the bezel and rear (instrument) support bracket to the panel.*

PTI-Style Instruments

PTI Instruments & Accessories	PTI Case Style			
	A	B	C	D
1120A			●	
2020A, 2030A, 2300A				●
2180A, 2189A, 2190A			●	
Y2000, Y2001	●			
Y2002			●	
Y2003, Y2009		●		
7220A, 7250A, 7260A, 7261A			●	
8860A				●
8920A, 8921A, 8922A			●	
Y5020				●
Y2023			●	

Y2024 3-Module Power Cord

Three 3-wire receptacles for powering two or three PTI-style instruments from one power outlet.

PTI Case Dimensions

Style	Height	Width	Depth
A	57 mm (2.25 in)	205 mm (8.05 in)	326 mm (12.85 in)
B	82 mm (3.23 in)		
C	105 mm (4.13 in)		
D	128 mm (5.03)		

Models

January 1986 prices

***A53**	Telescopic Whip Antenna	$30
Y1703	4m (13 ft) Null Modem Cable	150
Y1705	25 cm (1 ft) Null Modem Cable	75
Y1707	2m (6.56 ft) Interface Cable	125
Y1708	10m (32.8 ft) Interface Cable	150
Y1709	1m (3.28 ft) Printer Cable	125
Y2010	3½" Rack Panel PTI, Single	90
Y2012	5¼" Rack Panel PTI, Single	90
Y2014	5¼" Rack Panel PTI, Single	90
Y2016	7" Rack Panel PTI, Single	90
Y2018	3.05" DIN Panel Mount PTI	90
Y2019	3.81" DIN Panel Mount PTI	90
Y2020	4.80" DIN Panel Mount PTI	90
Y2021	5.70" DIN Panel Mount PTI	90
Y2024	3-Module Power Cord	20
Y5003	1.52m (5 ft) Interface Cable	125
Y5004	3.05m (10 ft) Interface Cable	135
***Y7201**	Attenuator/Filter (Counters)	65
Y8021	Shielded Cable, 1m (39.4 in)	85
Y8022	Shielded Cable, 2m (78.8 in)	95
Y8023	Shielded Cable, 4m (13 ft)	105
Y8834	Single Rack Mount, 8840A, 8842A	35
Y8835	Dual Rack Mount, 8840A, 8842A	75
Y8836	Center Rack Mount, 8840A, 8842A	125
***Y9100**	6 dB Attenuator	55
***Y9101**	14 dB Attenuator	55
***Y9102**	20 dB Attenuator	55
***Y9103**	50-ohm feedthrough termination	35
***Y9106**	BNC "T"	20
***Y9107**	BNC "T"	15
***Y9108**	BNC Jack to Double Banana Plug	15
***Y9109**	BNC Plug to Bindining Posts	20
***Y9110**	BNC Jack for Printed Circuit Boards	20
***Y9111**	Coaxial Cable 0.93m (3 ft)	20
***Y9112**	Coaxial Cable 1.85M (6 ft)	20
***Y9113**	BNC Plug to Double Banana Plugs	20
***Y9114**	BNC Jack to Phone Plug	20
***Y9115**	BNC Plug to Phone Jack	20
***Y9116**	BNC Jack to Phono Plug	20
***Y9117**	Phono Jack to BNC Plug	20
***M00-100-714**	Dust Cover	10
***M00-200-611**	3½" Rack Mount, Offset	35
***M00-200-612**	3½" Rack Mount, Center	35
***M00-200-613**	3½" Rack Mount, Dual	50
***2160A-7031**	3½" Rack Mount Panel, Single	90
***2160A-7032**	3½" Rack Mount Panel, Double	90
***2160A-7033**	3½" Rack Mount Panel, Triple	90

**Available through Distributors. See page 248*

Meaning of Limited Demand

The instruments described on these pages represent a desirable choice in a few specialized cases. Recommended substitutes are usually given with the description.

Differential Voltmeters

887AB

Fluke Differential Voltmeters, at one time, were the most accurate kind of voltmeters available. They are still exceptionally accurate but their principal remaining advantage is their extremely high input impedance for dc "at null," a setting where input voltage is most accurately measured. When measuring voltage from relatively high impedance sources, the input impedance of any voltmeter acts as a load and has a very significant effect on the accuracy of the measurement. Differential voltmeters reduce the measurement error in such cases.

Because analog meters are used on the front panel of differential voltmeters to indicate a null condition, they also provide a good visual monitor of small voltage changes and trends.

Differential Voltmeter Selection Guide

Model	DC Resolution	AC Sensing	Infinite Impedance
893A	10 μV	Average	To 1100V
895A	1 μV	N/A	To 1100V
887AB	1 μV	Average	To 11V
931B-01	No DC	True RMS	N/A

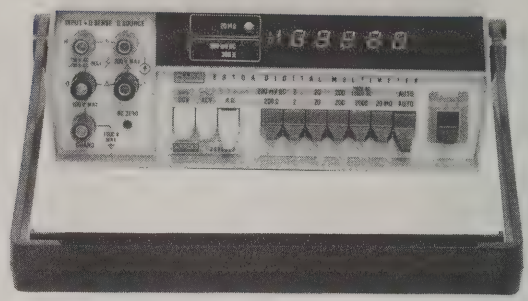
893A Differential Voltmeter	$3470
895A Differential Voltmeter	5090
887AB Differential Voltmeter	5995
931B-01 Differential Voltmeter	4395

382A Voltage/Current Calibrator

The 382A combines a ±0.01% voltage calibrator and a ±0.02% current calibrator. Current mode offers 0 to 2A in four ranges. Voltage outputs are available in two ranges: 0 to 50V dc and 0 to 5V dc. Resolution is 10 μV for voltage and 0.1 μA for current with a stability of 0.005%/mo. Voltage and current limiting are adjustable. The 382A is short-circuit proof.

382A DC Voltage/Current Calibrator	$5785

8810A Digital Multimeter



8810A

The 8840A Digital Multimeter is the recommended replacement for the 8810A.

The 8810A is a low cost, high precision, 5½-digit, autoranging digital multimeter that may be bought with or without built-in options. The choice of options not only lets you satisfy specific immediate applications in the most economical way but lets you add capabilities to match changing requirements later.

Model	January 1986 prices
8810A Digital Multimeter	$945

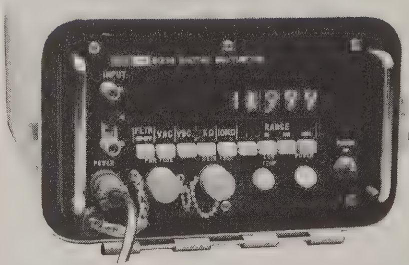
Options*

8810A-02 BCD Data Output	225
8810A-07 Resistance	199
8810A-07K Field Installable Resistance	220
8810A-08 Average Responding AC Volts	170
8810A-08K Field Installable Average Responding AC Volts	190
8810A-09 True-RMS AC Volts	295
8810A-09K Field Installable True-RMS AC Volts	325
8810A-521 PTI Output Interface	220
8810A-521K PTI Output Interface, Kit, Field Installable	250
88XXA-522K 1120A Interface, Kit, Field Installable	135
8810A-529** IEEE-488 Output Interface	325
C89 Carrying Case	20

**Option -02 cannot be used with -521, -522, or -529. Option -08 cannot be used with -09. Option -529 is comprised of -521 plus -522.*

***The -529 Option can be ordered and installed at time of manufacture only. For existing instruments which do not have -529 Option installed, an IEEE interface can be added by ordering -521K and -522K (1120 also required).*

Digital Multimeter 8125A and 8425A



8125A

Model 8125A is a compact, militarized 4½-digit digital multimeter designed to meet MIL-T-28800B, Type II, Class 2, Style A requirements for rugged field applications. Prices on request.

Model 8425A is a ruggedized 5½-digit rack mounted digital multimeter, designed for system applications, that meets the requirements of MIL-T-28800B, Type II Class 4, Style B.

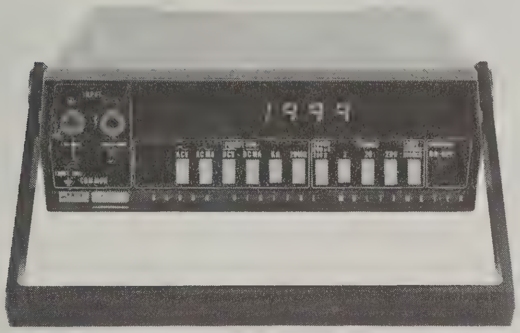
The functions, ranges, and performance of the 8425A are identical to those of the discontinued 8400A. Prices on request.

80F-15 Precision High Voltage Probe

The 80F-15 probe precisely divides inputs by 1000:1 to allow measurement of voltages to 15 kV dc. Accuracy is ±0.05% of input into 10 MΩ ±0.1% voltmeter input, 1 year, 23°C ±1°C.

80F-15 High Voltage Probe (10 MΩ cal)	$695
80F-15-01 High Voltage Probe (11 MΩ cal)	695
80F-15-02 High Voltage Probe (10^{10}Ω cal)	695

8000A Digital Multimeter

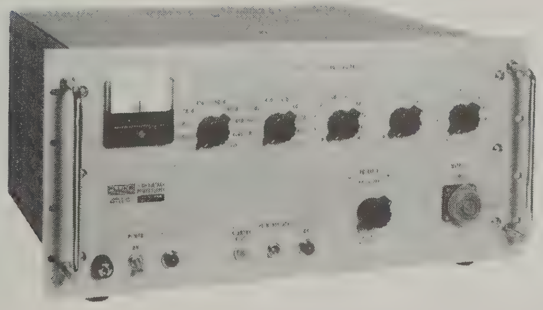


8000A

A classic 3½-digit DMM with LED readout. The 8010A, 8012A, or 8050A with LCD readout are recommended replacements.

8000A DMM	$595
8000A-01 DMM w/Rechargeable Batteries	$645
8000A/MAS for x-ray testing	$795

High Voltage Power Supplies

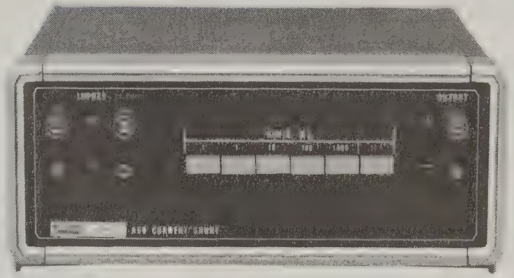


410B

The 410B and 415B are extremely stable dc sources that cover the range of 0 to 10,000V with 5 mV resolution and 0.25% calibration accuracy. The 410B provides 0 to ±10,000V at 10 mA maximum output current. The 415B covers from 0 to ±3100V at 30 mA maximum. Both models include adjustable over-current protection.

410B High Voltage Power Supply	$4650
415B High Voltage Power Supply	2995

A-90 Current Shunt

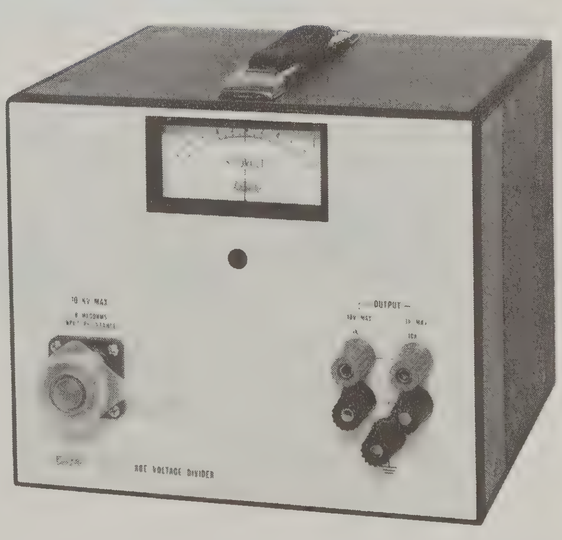


A-90

The model A-90 Current Shunt may be used for both ac and dc current measurements over six current ranges from 0.1 mA range to 10A range. A voltage of 100 mV, measurable with virtually any voltmeter, is developed at full scale on each range. Basic accuracy is ±0.15% for dc, ±0.3% for ac.

A-90 Current Shunt	$595

80E-10 High Voltage Divider



80E-10

The 80E-10 is a voltage divider designed for use with voltmeters in measuring up to 10,000V dc. Divider outputs at 10V and 1V are proportional to 10 kV dc input and are accurate to ±0.01%. High measurement stability and accuracy are assured through the use of Fluke manufactured precision wire-wound resistors mounted on glass-epoxy printed circuit boards.

80E-10 High Voltage Divider	$1160

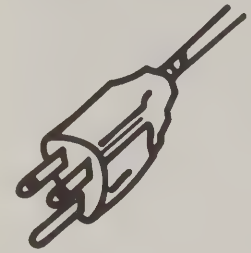
POWER CORD

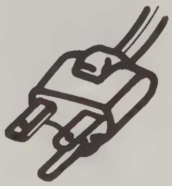
Power Cord and Plug Options

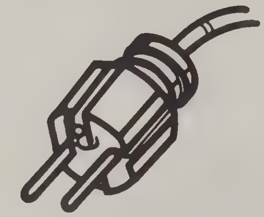
Fluke instruments requiring line voltage are fitted with one of the power cord and plug options shown below and are wired for the voltage indicated. The power cord supplied with your instrument is the one most commonly used in the country where the instrument will be delivered.

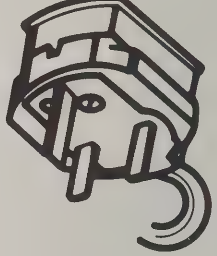
If you require a power cord and plug other than the one listed for the country where the instrument will be delivered, specify that power cord and plug when you order.

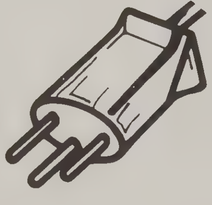
North American	120V/15A	Option LC-1
North American	240V/15A	Option LC-2
Universal Euro	220V/16A	Option LC-3
United Kingdom	240V/13A	Option LC-4
Switzerland	220V/10A	Option LC-5
Australian	240V/10A	Option LC-6
South African	240V/5A	Option LC-7

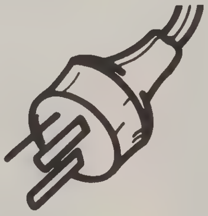

LC-1

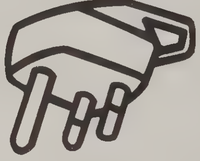

LC-2


LC-3


LC-4


LC-5


LC-6


LC-7

WARRANTY INFORMATION

The Fluke Warranty

Fluke warrants each product it manufactures to be free from defects in material and workmanship under normal use and service. The warranty applies anywhere in the world. The warranty period is listed below.

1-Year Warranty — Most Fluke products are warranted for 1 year.

2-Year Warranty — Fluke 25, Fluke 27, Models 8020B, 8021B, 8024B, 8025A, 8026B, 8842A.

3-Year Warranty — Fluke 21, Fluke 23, Fluke 73, Fluke 75, Fluke 77.

90-Day Warranty — 1765A/AB, Replacement Parts, Module Exchange, Standard Price Repairs.

90-Day On-Site — 3010A, 3040A, 3050B, 3051B, 3053A.

90-Day On-Site System Warranty Plus 9-Month Service Center Warranty on Instruments — 7405A, 7410A, 2452MCS, 3200B.

Software is warranted to operate in accordance with programmed instructions on appropriate Fluke products; it is not warranted to be error free.

Warranty Terms and Conditions

This warranty extends only to the original Purchaser and shall not apply to fuses, computer media, batteries or any Product which, in Fluke's sole opinion, has been subject to misuse, alteration or abnormal conditions of operation or handling. The warranty period shall be controlled by the warranty document furnished with each Product and shall begin on the date of shipment.

For warranty service, contact a Fluke Service Center or send the instrument, with the description of the difficulty, postage prepaid, to the nearest Fluke Service Center. Fluke assumes no risk for damage in transit. Fluke will, at its option, repair or replace the defective instrument free of charge. However, if Fluke determines that the failure was caused by misuse, alteration, accident or abnormal condition of operation, Purchaser will be billed for the repair. The repaired instrument will be returned, transportation prepaid.

THE FOREGOING WARRANTY IS BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OR MERCHANTABILITY OF FITNESS FOR A PARTICULAR PURPOSE OR USE. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSS WHETHER IN CONTRACT, TORT, OR OTHERWISE.

Calibration & Specifications

A Certificate of Calibration comes with every Fluke serialized measurement or calibration product except those indicated as "Available through Distributors." The Certificate of Calibration includes the Model and Serial number and states that the unit delivered was calibrated with standards traceable to the National Bureau of Standards. Traceability records are maintained per MIL-STD-45662.

Products marked Available through Distributors include a Statement of Calibration Practice.

Special calibration reports that include numerical values pertaining to the calibration are available for a modest fee. Contact your Fluke Sales Office or Representative.

Specifications in this catalog are those that apply at the time of printing. Fluke reserves the right to change specifications without notice.

Special Instruments and Systems

Many Fluke instruments can be supplied with non-standard paint, altered specification ranges, special connectors, or other special features. Some automated systems may be assembled and customized to your requirements, also. Contact the Fluke Representative or Sales Office in your area.

Prices and Terms

Prices are F.O.B. origin unless otherwise specified, apply only when the final destination is within the U.S.A., are in U.S. funds, and are subject to change without notice.

Upon request, quotations, or pro forma invoices will be furnished to you by Fluke or Fluke Sales Representatives.

U.S. terms are 30 days net. Unless credit has already been established, shipments will be made C.O.D. or on receipt of cash in advance. Terms for orders from other countries are either an irrevocable letter of credit or cash in advance, unless other terms have been previously arranged.

TECHNICAL LITERATURE AVAILABLE

Service Information

Ask your local Fluke Technical Center for a free copy of any literature you may need. Or use a reply card, if you prefer. Please use both title and number.

Digital Multimeters and Voltmeters

Auto-Zero Circuit 8300A, Inverting Amplifier	C0045
Digital Voltmeter Guard Terminal Connection	C0048
Installation of Fuse Holder in the 8300A MV/Ohm	C0055
Troubleshooting Feedback Amplifiers	TB-2
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931A Digit Switch Installation Instructions	C0042

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5205 Troubleshooting Notes & Procedures	C0083
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Safety Check of Line Fuseholder Wiring (410B)	C0079
415B Over Current Modification	C0052

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Troubleshooting Into IEEE-488	C0076
Troubleshooting AC Converters	C0090
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Calibration Services	J0230A
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On-Site Maintenance Agreements	J0242A
Fluke Module Exchange Program	E0031B
System Application Consulting	E0027A
Instrument and Systems Maintenance Training Program	E0035A
2452MCS Training Course	E0030A
2280A/B Introductory Training Seminar	E0034A
7400 Procedure Writing Training Course	E0028A

Application Information

Ask your Fluke Sales Office or Representative for a free copy of any literature you may need. Or use a reply card, if you prefer. Please use both title and number.

Micro-System Troubleshooters

9010A Avoiding Potential Problems When Getting Started	B0127
The Probe and the Program	B0163
IEEE-488 Production Test	B0146
Remote Operation	B0147
Guide to 8085 Microprocessor-Based System Testing	B0151
31 Most Often Asked Questions About the Fluke 9010A	B0155
9000A Series User Designed Interface Pod Adapters	B0156
Portable Tester Learn Boards to Simplify Service (Electronics, 6/81)	F0016
Designing Microprocessor-Based Systems for Testability (Electronic Test, 10/83)	F0032
9000A Series Introductory Training Manual	J0178
Fluke Troubleshooter A Collection of Articles for Users	P0003

Digital Multimeters and Voltmeters

Measuring High Resistance Using the 8860A	B0095
Zener Diode Testing Using the 8860A	B0096
Measuring Power Supply Regulation Using the 8860A	B0103
8520A Burst Measurements	B0107
Analog Bar Graph Applications Using Fluke 70 Series Multimeter	B0158
Automotive Applications for Fluke Multimeters	B0164
8060A Custom Chip Adds Frequency to Handheld Meter (Electronics 5/82)	F0019
T&M Update: Handheld Multimeter (Electronic Engineering Times 6/84)	F0035
The On-Site Fluke Story (Model 77) (Vector, May 1984)	F0036
Digital Multimeter Packaging Tackles Harsh Environments (Electronic Packaging & Production, 10/84)	F0045
Selecting True RMS & Averaging DMMs	G0098
Multimeter Safety	G0101

Calibrators and Standards

Cost Optimized Calibration 5100B Series (Was AB-43)	B0055
Questions & Answers on the 7410A Automated Calibration System	B0137
Additional 7105A Calibration Techniques	B0141
7400A Series Financial Analysis for Automated Test System Procurement	B0148
7400A Series Financial Analysis Information	B0149
Questions & Answers on the 5440A Direct Voltage Calibrator	B0152
Calibration — Philosophy in Practice	E0010
Calibrator Brings Record Accuracy Event to Production & Repair (5440A) (Electronics 9/82)	F0021
Calibration Synergies: The Impact of the Embedded Microprocessor and Non-Volatile Memory (Test & Measurement World 10/84)	F0046

Instrument/System Controllers (1720A/1722A)

Floppy Disk	B0076
Startup, Self Test, FDOS and CONMON	B0077
File Utility Program Fundamentals	B0078
Communication over the IEEE-488 Bus	B0079
Stripping Remarks and Extra Spaces from your BASIC Program	B0090
Converting Binary Data to Floating Point Numbers	B0091

TECHNICAL LITERATURE AVAILABLE

System Command File	B0097
Disk Initialization	B0098
Modification of Files	B0099
Copying/Transferring Files	B0100
RS-232C Interfacing to Serial Printers	B0101
E-Disk	B0123
BASIC Main Memory Arrays	B0142
An Introduction to Virtual Arrays	B0143
Programming with Virtual Arrays	B0144
Relocating Object Files	B0154
Plotter Routine Library	B0162

Data Acquisition 2280 SERIES/2200B/2240C

In Direct Computer Control Testing of Refrigeration	AL-1024/D0010
In Location Analysis of Electric Power Sub-Stations	AL-1026/D0012
In Measuring Paper Plant "Red Liquor" Production	AL-1027/D0013
To Monitor Compressor Engines on an Offshore Oil Platform	AL-1029/D0015
To Monitor Cyrogenic Temperatures Aboard Liquid Natural Gas Tankers	AL-1030/D0016
Monitoring the Environment of the United Kingdom Priceless Art Treasures	AL-1031/D0017
Road Testing With a Battery Powered 2280A Data Logger	AL-1041/D0027
Using the 2280A to Test a Fluidized Coal Pilot Plant	AL-1044/D0030
Using the 2280A to Test Digital Audio Disks	AL-1045/D0031
Using the 2280A Data Logger to Test Power Supplies	AL-1046/D0032
Using the 2280A Data Logger to Test Helicopter Air Speed Sensors	AL-1047/D0033
Using the HP 9825 Calculator with the 2240B Data Logger	AB-45/B0058
Data Logger Expands to 1500 Point/Data Acquisition and Control System (Control Engineering 9/82)	F0025
Temperature and Sterilization: Accurate Temperature Measurement Increases Productivity of Autoclave Sterilization (Medical Electronics Magazine 9/83)	F0029
Data Loggers in Test Measurement (Test & Measurement World 9/83)	F0033
Data Loggers, Use and Selection (CPI100 Sept/Oct 1984)	F0042
2280A Data Logger Operator's Notebook	J0222

2400B/2452MCS

Intelligent Computer Front End — Software Dialog	A0202
For Fire Testing	AL-1032/D0018
To Monitor Remote TV Transmitting Stations	AL-1033/D0020
To Test Steam Turbines	AL-1034/D0019
To Control Hot Runner Temperatures in a Plastic Injection Molding Process	AL-1035/D0021
For Wire Harness Testing	AL-1036/D0022
To Monitor a Gas Pipeline Main Compressor Station	AL-1037/D0023
To Monitor a Steel Mill's Basic Oxygen Furnaces	AL-1038/D0024
To Control Stress and Rupture Testing Furnaces	AL-1039/D0025
Using the 2400A for Environmental Testing of Electronic Components	AL-1040/D0026
Using the 2400A to Monitor and Control Petrochemical Pilot Plants	AL-1042/D0028
Using the 2452MCS with Stepper Motor Controller Option to Run a Factory Pick-and-Place Machine	AL-1043/D0029
Using the 2400A Series for Gas Flow Metering & Control	AL-1049/D0035
Furnace Control and Monitoring	AL-1050/D0036
2400B-001 Serial Interface	B0159
Computerized Engine Test System Introduced — Diesel Progress North American	F0026
Language PC Automates Sugar Blending Process (PC User Magazine 9/83)	F0028
Runnerless Tooling: A Fast and Reliable Way to Mold Any Material (Modern Plastics 10/83)	F0030
Flexible Test Systems Cut Costs and Hike Production-Line Turnarounds (Electronics 5/84)	F0037
Computer-Based Data Acquisition Reduces Static Strain Measurement Errors (Control Engineering 9/83)	F0039
Efficiency of Chemical Process Development Increased by Computerized Control System (Chemical Processing 10/84)	F0047
Process Control, Plant Information Integrated by Management System; Measurement, Control Device Bridges Analog-Digital Gap; 1984 Chemical Processing Vaaler Award (Chemical Processing, Mid Nov/84)	F0048

Digital Thermometers

Test or Calibrate Thermocouple or Millivolt Indicators (2190 + Y2003) (Was AB-47)	B0059
Thermometry System Limits Option Alarms, Peak Memory, Deviation (21X0A-006) (Was AB-46)	B0061
2300A Temperature Scanner: Typical PTI Applications (Was AB-51)	B0074
Case Studies in Temperature Measurement	AL-1048/D0034
Thermocouples, RTDs Can Boost Temperature Measurement Accuracy (Industrial Research & Development 11/83)	F0031
Thermoelectric Thermometry (TCs and RTDs)	J0004

Printers

"Computing" Printer Solution — Some Typical Instrumentation Applications (2030A) (Was AB-50)	B0068
Printer Configuring Guide (2020A)	AB-49/B0120

Signal Sources

Systems Use of the 6010A Synthesized Signal Generator	AB-21/B0047
Systems Use of the 6011A Synthesized Signal Generator	AB-22/B0048
Signal Generator Primer	B0121
Filter Testing Using the 6070A and 6071A Synthesized Signal Generators	B0124
6070A/6071A Phase-Noise Measurement	B0125
A Test Set for the Accurate Measurement of Phase Noise on High-Quality Signal Sources	B0150
Understanding Precision Crystal Time Bases (Electronics 8/78)	F0007
Delay Lines Give RF Generator Spectral Purity, Programmability (Electronics 8/80)	F0013

Frequency Counters

Data Output Option (-02) for the Fluke Model 1900A Multi-Function Counter	AB-24/B0063
Practical Counter Applications	AB-39/B0073
Understanding Precision Crystal Time Bases (Electronics 8/78)	F0007
Compact Low-Cost Counters Carry Lab to Field (7200 Series) (Electronics 7/79)	F0008

PC Board Testers

MDA Enhancement Sports New Chip, PMU and Software (Electronics Test 9/84)	F0040
Manufacturing Defects Analyzers Catch Flaws Before In-Circuit and Functional Test (Electronics Test 10/84)	F0041
Why In-Circuit Testing Isn't Enough	G0085
Offloading Functional Testers	G0089
Offloading In-Circuit Testers	G0090
Third Party Programming Folder	J0163
Testing Z80 Microprocessor on the 3040A	L0001
Testing the Motorola 6802 Microprocessor (3040A)	L0002
March Pattern Memory Test (3040A)	L0003
Testing 8080-Based Boards on the 3040A	L0004
Interfacing 8085 Boards to the 3040A	L0005
Unconnected Output Errors	L0006
Using Autotrack in a Loop (3040A/3050A)	L0007
External Input Bus (EIB) (3040A/3050A)	L0009
Counter Initialization Functional Testing (3000 Series)	L0010
Expanding 2-Way Bus Capability (3010A/3020A)	L0011
Oversized PCB Mounting (3000 Series)	L0012
Testing Static Memories (3000 Series)	L0014
Program Debug (3020A/3040A/3050A)	L0015
Pin Electronics for the 3050A	L0016
Testing Reactive Components with the 3200A	L0017
Expanding Models 3040A/3050A to Test PCBs With More Than 240 Pins	L0018

General

IEEE Standard 488-197 Digital Interface for Programmable Instrumentation	AB-36/B0053

U.S. GOVERNMENT SALES & SUPPORT

Government Operations Offices

Fluke sales offices (see page 243) and the Government Operations offices listed here have the latest information on provisioning, nomenclature, and National Stock Numbers.

National Program and Accounts Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Air Force Military and Accounts Manager
10417 Gulfdale
San Antonio, TX 78216
(512) 340-2621

4756 Fishburg Rd.
Dayton, OH 45424
(513) 233-2238 (Dayton)

Army Military and Accounts Manager
4920 Corporate Drive
Suite J
Huntsville, AL 35805-6202
(205) 837-0581

Navy Military and Accounts Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

16969 Von Karman
Suite 100
Irvine, CA 92714
(714) 863-9031

Security Military and Accounts Manager
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

U.S. General Services Administration

Most of the instruments in this catalog are available on the following General Services Administration Contracts in FSC Group 66, Part II, Sections "H" and "J", Class 6625:

Contract	Period	Category
GS00F78460 (Section H)	September 4, 1985 to July 31, 1988	Electrical/ Electronic Components & Test Equipment
GS00F70562 (Section J)	August 3, 1984 to May 31, 1987	Instruments: Measuring and Testing

Special Products, Systems, and Services

Listed below are examples of products, systems, and services that specifically support Government applications.

Products

Model 6060A/AN Synthesized Signal Generator (NICM 7Z-6625-LL-HHE-4228TE). A low-cost efficient signal generator and FM deviation meter with a frequency range of 10 kHz to 520 MHz. (See page 65.)

Model 8520A/AS-1 System Multimeter. Certified by the Air Force as the first module to complete all requirements imposed by the Modular Automated Test Equipment (MATE) Program. (See page 19.)

Model 8025A Multimeter (NSN 6625-01-147-6182). A handheld instrument designed to the ruggedized requirements of MIL-T-28800 Type II, Class 2, Style A. (See page 45.)

Model 8050A-01 Multimeter (AN/USM-486/U NSN 6625-01-145-2430). A 4½-digit multimeter with 85 RF Probe selected by the Army as the preferred benchtop multimeter for multi-service maintenance and repair testing. (See page 28.)

Model 8840A/AF Digital Multimeter (NSN 6625-01-196-0014). A low-cost, high-accuracy 5½-digit multimeter for bench and system applications. (See page 2.)

Model 77/AN Digital Multimeter (NICM 1H-6625-LL-HHE-4204 TE). A very low-cost 3½-digit handheld multimeter with 0.3% dc accuracy and special features including "Touch Hold." (See page 36.)

Systems

MECCA (Modularly Equipped and Configured Calibrators and Analyzers). Provides the Navy with automatic calibration capability on-site under rigorous conditions by integrating the Fluke 1722A/AP Instrument Controller, 5102B Meter Calibrator and 8506A/AN Digital Multimeter.

Model A123 Automated Calibration System. A high accuracy mobile calibration system, configured to calibrate 5½- and 6½-digit DMMs automatically.

Software

FlexSys (ATLAS Test Software). FlexSys is a complete software package that runs on Fluke's powereful IEEE-488 controller, the 1722A. With FlexSys and the ease of resource descriptions, reconfiguration is rapid and easy without recompiling or modifying test procedures or test program sets. (See page 202)

Services

Direct Voltage Maintenance Program. (See page 121.)

Application Training. Some of the courses presently available, including several which are complimentary with a system purchase, are identified below. Contact your local Fluke sales office or Government Operations field office for the most current information on course/seminar content and attendance considerations.

2450MCS Measurement and Control System Training Course
3040A-1 Digital/Analog Board Test System Training Course
3050B Digital/Analog Board Test System Training Course
3200A Manufacturing Defect Analyzer Training Course
6070A/6071A Signal Generator RF Seminar
7405A/7410A-100 Automated Calibration System Intermediate Training
9000A Micro-System Troubleshooter Introductory Training
(Basic and Advanced courses)

Maintenance Training. Fluke understands the needs of certain customers to possess their own maintenance capability. Maintenance training courses currently scheduled for presentation in 1986 at various Technical Service Centers include:

2280 Data Logger
2400 Intelligent Computer Front End
3040/3050 Functional PCB Tester
3200 Manufacturing Defects Tester
3330 Calibrator
5100/5101/5102 Calibrator
5200 Programmable AC Calibrator
5215 Calibrator Power Amplifier
5440 Direct Voltage Calibrator
8500/8502/8505/8506 DMM Portable Digital Multimeters
4200 Series DACs

Logistics Data Book

The Fluke Logistics Data Book is available from your local sales office. This document provides comprehensive information including National Stock Numbers, military nomenclature and replacement model numbers as well as products, systems, and services which offer benefits tailored to special government/military requirements. Detailed listings of available application and maintenance training plus technical literature are also included.

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Brisbane, Queensland 4001
Australia
Tel: 369-8688

AUSTRIA
Walter Rekirsch Elektronische Gerate GmbH & Co.
Vertrieb KG
Obachgasse 2B
1220 Vienna, Austria
Tel: 235555

B

BELGIUM
Fluke (Belgium) S.A./N.V.
6 Rue de Geneve
1040 Brussels, Belgium
Tel: 2164090

BRAZIL
Hi-Tek Electronica Ltda.
Al. Amazonas 422
Alphaville, Barueri
CEP 06400 Sao Paulo, Brazil
Tel: 421-5477

C

CHILE
Intronica Chile Ltda.
Casilla 16228
Santiago 9, Chile
Tel: 44940

CHINA, PEOPLES REPUBLIC OF
Instrimpex - Fluke Service Center
57, Xisi Dong Da Jie
Xicheng-qu, Beijing
People's Republic of China
Tel: 65-7281

COLOMBIA
Sistemas E Instrumentacion, Ltda.
Carrera 13, No. 37-43, Of. 401
Ap. Aereo 29583
Bogota DE, Colombia S.A.
Tel: 232-4532

D

DENMARK
Tage Olson A/S
Ballerup, Byveg 222
2750 Ballerup
Denmark
Tel: 658111

E

ECUADOR
Proteco Coasin Cia., Ltda.
Ave. 12 de Octubre #2285 y
Orellana
Quito, Ecuador
Tel: 526759

EGYPT AND SUDAN
Electronic Engineering Liaison Office
P.O. Box 2891 Horreya
11361 Heliopolis
Cairo, Egypt
Tel: 695705

ENGLAND
Fluke (GB) Ltd.
Colonial Way
Watford, Herts, WD2 4TT
England
Tel: 40511

Amtest Associates Ltd.
31 Clarence Street
Staines, Middlesex TW18 4SY
England
Tel: 63555

F

FINLAND
Instrumentarium Elektroniikka
P.O. Box 64, Vitikka 1
02631 ESPOO 63
Finland
Tel: 358-0-5281

FRANCE
M.B. Electronique S.A.
606, Rue Fourny
P.O. Box 31
78530 BUC, France
Tel: 9568131

G

GREECE
Hellenic Scientific Representations Ltd.
11 Vrassida Street
Athens 612, Greece
Tel: 7211140

H

HONG KONG
Schmidt & Co (H.K.) Ltd.
18th Fl., Great Eagle Centre
23 Harbour Road
Wanchai, Hong Kong
Tel: 8330222

I

INDIA
Hinditron Services Pvt. Ltd.
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8th Main Road
33/44-A Raj Mahal Vilas Extn.
Bangalore 560 080, India
Tel: 33139

Hinditron Services Pvt. Ltd.
1st Floor, 17-B, Mahal Industrial Estate
Mahakali Road Andheri East
Bombay 400 093, India
Tel: 6300043 or 6300527

Hinditron Services Pvt. Ltd.
15 Community Centre
Panchshila Park
New Delhi, 110 017, India
Tel: 661869

Hinditron Services Pvt. Ltd.
1-1-58/1 to 1-1-58/11
Sarojini Devi Road
Secunderabad 500 003, India
Tel: 821117

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P.T. DWI Tunggal Jaya Sakti
P.O. Box 4435
Wisma Harapan Bldg., 14th Flr.
Jl. Jend. Sudirman Kav. 34
Indonesia
Tel: 584685

ISRAEL
T.D.T. Electronics Engineering Ltd.
P.O. Box 43137
Tel Aviv 61430
Israel
Tel. 483211

ITALY
Sistrel S.p.A.
Via Pelizza da Volpedo 59
20092 Cinisello Balsamo
Milan, Italy
Tel: 6181893

J

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John Fluke Mfg. Co., Inc.
Japan Branch
Sumitomo Higashi Shinbashi Bldg.
1-1-11 Hamamatsucho
Minato-ku, Tokyo 105, Japan
Tel: 434-0181

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Myoung Corporation
Rm #1501, Sinsong Bldg.
25-4 Yeouido-dong, Young Deung PO-KU
Seoul 150, Korea
Tel: 82-2-784-9942

M

MALAYSIA
Mecomb Malaysia Sdn. Bhd.
Lot 20, Jalan 225
P.O. Box 24
Petaling Jaya, Malaysia
Tel: 743422

MEXICO
Mexicana de Electronica Industrial, S.A. (Mexel)
Diagonal No. 27
Entre Calle de Eugenia Y Ave
Colonia del Valle
C.P. 03100, Mexico
Tel: 90-5-660-4323

N

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Fluke (Nederland) B.V.
Gasthiusring 14
5000 AC Tilburg
The Netherlands
Tel: 352455

Fluke (Holland) B.V.
P.O. Box 2269
5600 CG Tilburg
The Netherlands
Tel: 458045

NEW ZEALAND
Northrop Instruments & Systems Ltd.
459 Kyber Padd Road, Newmarket
Private Bag, Newmarket
Auckland 1, New Zealand
Tel: 64-9-501-801

Northrop Instruments & Systems Ltd.
First Floor, Northrop Bldg.
189-191 Willis Street
P.O. Box 2406
Wellington, New Zealand
Tel: 64-4-856-658

NORWAY
Morgenstierne & Co. A/S
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel: 356110

P

PAKISTAN
Pak International Operations
505 Muhammadi House
I.I. Chundrigar Road
P.O. Box 5323
Karachi Pakistan
Tel: 221127/239052

PERU
Importaciones Y Representaciones Electronicas S.A.
Avda. Franklin D. Roosevelt 105
Lima 1, Peru
Tel: 288650

PHILIPPINES
Spark Radio and Electronics Corp.
Greenhills P.O. Box 610
Metro-Manila Zip, 3113
Philippines
Tel: 63-2-775192

PORTUGAL
Equipamentos de Electronica e Cientificos, SARL.
Av. Bombeiros Voluntarios,
Lote 102B
Miraflores/Alges
1495 Lisboa, Portugal
Tel: 2103420

R

S

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98 Pasir Panjang Road
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P.O. Box 39797
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Republic of South Africa
Tel: 786-3170

SPAIN
Equipos Y Sistemass.A. (ESSA)
Apolanio Morales, 13B
Madrid 16, Spain
Tel: 4580150

SWEDEN
Teleinstrument AB
P.O. Box 4490
S-162 04 Vallingby 4
Sweden
Tel: 380370

SWITZERLAND
Traco Electronic AG
Jenatschstrasse 1
8002 Zurich
Switzerland
Tel: 2010711

T

TAIWAN
Schmidt Scientific Far East Ltd.
5th Floor, Cathay Min-Sheng
Commercial Bldg., 344
Min-Sheng East Road
Taipei 104, Taiwan
Tel: 5013468

THAILAND
Measuretronix Ltd.
2102/63 Ramkamhaeng Rd.
Bangkok, 10240
Thailand
Tel: 3780632

TURKEY
Erkman Elektronik Aletler
Ticaret Anonim Sirketi
Necatiby Cad 92/3
Karakoy, Istanbul, Turkey
Tel: 441546

U

URUGUAY
Coasin Uruguaya S.R.L.
Libertad 2529
Casilla de Correo 1400
Montevideo, Uruguay
Tel: 789015

V

VENEZUELA
Coasin C.A.
Calle 9 Con Calle 4
Edif. Edinurbi
Apartado de Correos Nr-70 136
Los Ruices
Caracas 1070-A, Venezuela
Tel: 239-0967

W

WEST GERMANY
Fluke (Deutschland) GmbH
Oskar-Messter-Strasse 18
Postfach 11 53
8045 Ismaning
West Germany
Tel: 9605240

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- 73/75/77 Handheld Multimeters
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- 8010A/8012A/8050A Bench Multimeters
- 8020B/8021B/8024B/8026B Handheld Multimeters
- 8060A/8062A Handheld Multimeters
- 2160A/2170A Series Digital Thermometers
- 9000 Series Micro-System Troubleshooters
  — Limited Distribution
- DMM Accessories
- TemPak Series Digital Thermometers
  — Limited Distribution

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(602) 884-7082 WYL

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(501) 562-2534 BRW
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Norwalk
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Stratford
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Wallingford
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(203) 265-3822 MAR
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(305) 242-8151 ROM
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(305) 871-3500 EEC
(305) 593-6060 ESL
Orlando
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(305) 849-6060 EMS
(305) 841-1878 MAR
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Pembroke Park
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Pensacola
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Tampa
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(813) 253-0104 EMS
(813) 870-3315 LEA
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St. Louis
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Fairport
(716) 381-7070 PIN
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(216) 587-3600 PIN
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(503) 884-4171 NCE
Medford
(503) 772-7131 NCE
Portland
(503) 228-5111 NCE
(503) 232-3404 RAD
(503) 233-5341 UNI
Tualitan
(503) 684-2570 NCE

Pennsylvania

Braddock
(412) 351-5000 LEF
Carlisle
(717) 243-8006 CUM
Drexel Hill
(215) 449-2300 KAS
Erie
(814) 453-5626 REM
Fort Washington
(215) 643-4050 GIS

AUTHORIZED DISTRIBUTORS

Harrisburg
(717) 233-5883 CUM
Lancaster
(717) 393-8304 CUM
Lewiston
(717) 248-9632 CUM
McKeesport
(412) 751-5966 BAR
Philadelphia
(215) 673-5600 SUN*
Pittsburgh
(412) 963-1885 CAM
(412) 731-5230 EIL
(412) 892-2953 NID*
(412) 782-2300 PIN
Plymouth Meeting
(215) 825-4990 TEC
Trevos
(215) 364-2830 BRO
York
(717) 845-8791 CUM
(717) 854-7804 YIS

Puerto Rico

Ponce
(809) 843-2260 TRE
San Juan
(809) 751-8375 BAC

Rhode Island

Cranston
(401) 944-2570 JAB
Pawtucket
(401) 728-4600 JAB

South Carolina

Charleston
(803) 722-2634 WIE
Columbia
(803) 772-6111 BRO
(803) 779-5332 DIX
(803) 256-0746 WIE
Florence
(803) 669-8201 DIX
Greenville
(803) 233-4121 EMS
(803) 235-8334 WIE

South Dakota

See Minnesota or Kansas

Tennessee

Chattanooga
(615) 267-9531 SPD
Gray
(615) 247-7125 DIX
Jackson
(901) 424-0236 BLU
(901) 422-6585 LAV
Knoxville
(615) 966-3441 BRO
(615) 938-4131 DIX
Memphis
(901) 345-9500 BLU
(901) 795-8487 BRO
Nashville
(615) 242-8000 BLU
(615) 889-8230 BRO
(615) 242-2682 GRA
Paris
(901) 642-7354 LAV

Texas

Addison
(214) 931-1236 EIL
Amarillo
(806) 372-5668 TWE
Austin
(512) 452-0199 BET
(512) 926-9220 BRW
(512) 837-3939 MAR
(512) 432-6222 NEI*†
(512) 835-4000 PIN
(512) 835-1052 RED
Beaumont
(713) 833-9443 RAL
(713) 838-0393 RAW
Borger
(806) 274-5281 TWE
Corpus Christi
(512) 289-2929 BRW
(512) 887-0001 RAW
Dallas
(214) 631-3380 ASC
(214) 631-3600 BRW
(214) 343-8800 BUT
(214) 320-9770 DAA
(214) 931-1236 EIL
(214) 243-7000 INO*
(214) 233-7650 MAR
(214) 233-0020 NEI*†
(214) 388-7300 PIN
(214) 653-1041 RED
(214) 257-3535 SPE
(214) 824-3001 WES
Deer Park
(713) 479-9705 RAW
El Paso
(915) 779-5697 RED
Fort Worth
(817) 336-5621 BRW
(817) 534-2752 TWE
(817) 336-0461 WES
Freeport
(409) 233-5451 BRW
(409) 233-6381 RAW
Garland
(214) 271-5671 MET*
(214) 494-5911 NEW
(214) 348-8800 TUK
Greenville
(214) 455-4360 LAV
Houston
(713) 688-9971 BET
(713) 694-2771 BRO
(713) 672-1100 BRW
(713) 464-4662 BUT
(713) 271-3100 EIL
(713) 688-7000 INO*
(713) 789-9300 MAR
(713) 777-1666 NEI*†
(713) 783-1629 NEW
(713) 988-5555 PIN
(713) 748-4902 RAL
(713) 688-8126 RAW
(713) 789-6610 SPE
(713) 879-9953 WYL
Hurst
(817) 589-1355 NEW
La Porte
(409) 471-1900 BRW
Lone Star
(214) 656-2584 BRW
Longview
(214) 757-3961 WES
Lubbock
(806) 747-2888 TWE
Lufkin
(409) 632-9900 BRW
McAllen
(512) 631-1168 RED
Midland
(915) 694-9657 ESI
(915) 684-4469 TWE
Nederland
(409) 722-8044 BRW
Odessa
(915) 333-3636 BRW
Paris
(214) 785-1711 LAV
Port Lavaca
(512) 552-7525 RAW
Richardson
(214) 783-1065 BET
(214) 690-4646 TWE
(214) 234-3392 USI
(214) 235-9953 WYL
San Antonio
(512) 333-7710 BRW
(512) 349-2967 RAW
Sherman
(214) 893-9585 BRW
(214) 892-9155 LAV
(214) 893-7421 TWE
Texas City
(409) 948-3446 RAW
Tyler
(214) 593-8421 BRW
(214) 597-6315 LAV
Victoria
(512) 575-4738 LAV
Wichita Falls
(817) 322-5509 BRW
(817) 322-2151 TWE
(817) 723-8106 WES

Utah

Salt Lake City
(801) 973-4455 BET
(801) 486-3371 SSC
(801) 974-9953 WYL

Vermont

See Massachusetts or
New York

Virginia

Alexandria
(703) 354-4330 EIL
Arlington
(703) 524-6256 ARL
Fairfax
(703) 591-7410 ASC
Norfolk
(804) 855-0105 PEL
Richmond
(804) 275-1431 MEM*
Springfield
(703) 569-2611 EIL
Vienna
(703) 938-3350 EEB
Virginia Beach
(804) 499-3746 EIL

Washington

Bellevue
(206) 641-6800 MAR
(206) 454-6922 NCE
(206) 454-1747 NCE
(206) 451-9393 UNI
(206) 453-8300 WYL
Bellingham
(206) 671-1100 NCE
Everett
(206) 259-7263 NCE
Longview
(206) 423-1550 NCE
Redmond
(206) 823-4111 VAN
Richland
(509) 943-8336 RAD
Seattle
(206) 576-1888 EIL
(206) 682-4444 NCE
(206) 282-2511 RAD
Spokane
(509) 922-1317 NCE
(509) 747-3053 RAD
Tacoma
(206) 383-1606 NCE

West Virginia

Charleston
(304) 348-5211 MCJ
Princeton
(304) 425-7594 MCJ

Wisconsin

Chippewa Falls PAC
(715) 723-1141
Green Bay
(414) 435-8331 NRT
Mequon
(414) 241-4321 TAY
Milwaukee
(414) 475-6000 MES
Oshkosh
(414) 235-8930 ELI

Wyoming

See Colorado, Nebraska,
or Utah

**2160/2170 Series Digital Thermometers also available through this distributor.*

†9000 Series Micro-System Troubleshooters also available through this distributor.

AUTHORIZED DISTRIBUTORS

Distributors

ACO	ACRO Electronics, Corp.
AEI	Alliance Electronics, Inc.
ALA	Alaska Electronics Supply
ARL	Arlington Electronic
ASC	Ames Supply Co
AST	AST/Servo Systems
ATR	Atrix Tool
AVI	Avionics Associates
BAC	B & C Calibration Center
BAR	Barno Radio Co.
BCC	Barber-Colman Co.
BET	Beta Distributors
BJW	B.J. Wolfe
BLU	Bluff City Electronics
BNC	B & C Instruments
BRG	Breard-Gardner
BRI	Brill Electronics Products
BRO	Brownell Electro
BRU	Bruckner Machine & Tool
BRW	Briggs-Weaver
BUT	Butler & Land
CAB	Carlton-Bates
CAL	Calcotron
CAM	CAM Instrumentation
CAS	C & S
CMK	Com Kyl
COD	Concorde Electronics
COE	Consolidated Electronics
COL	Col. Spgs. Walker Elec.
COM	Commodore I
CON	Contact East
COR	Corning Electronics
CUM	Cumberland Electronics, Inc.
DAA	Dallas Avionics
DAL	Dalis Electronics
DIX	Dixie Electronics
DOL	Dolphin Electronic Supply
DUN	Dunlap Electronics
EEB	Electronic Equipment Bank
EEC	Electronic Equipment Co.
EET	E.E. Taylor
EIL	EIL Instruments
ELI	Electronic Industries, Inc.
EMS	EMSCO Div. Hammond
EPC	Electronic Parts Co.
ESI	ESI Supply Co.
ESL	E.S.L.
ESU	Electronic Supply
ETC	Electronic Tool Co
GIS	Garrett Industrial Supply
GOE	Gopher Electronics
GOL	Goldcrest Electronics, Inc.
GRA	Graham Electronics
HAT	Hatry Electronics
HHS	Herman H. Sticht
HON	Honolulu Electronics
HUG	Hughes-Peters
HUR	Hurley Electronics
IDA	Idaho Instruments
IIW	Industrial Instrument Works
INE	Instrument Engineers
INL	Inland Electronics Supply
INM	Instrument Mart
INO	INOTEK
INS	Instrumentation Services
ISL	Industrial Service Labs
ITC	ITC Electronics
JAB	Jabbour Electronic Supply
JEN	Jensen Tools, Inc.
JLS	JLS Industrial Electronics
JON	Jones Electronics
JOS	Joseph Electronics
KAS	KASS Electronics Dist.
KAU	Kaufman Co.
KBT	KB Tool & Supply
KEM	KEMS, Inc.
KIE	Kiesub Corporation
KLA	Klaus Radio
LAV	Lavender Distributing
LEA	Leader Electronic Dist.
LEF	Leff Electronics
MAR	Marshall/Claude Michael
MCJ	McJunkin Corp.
MEM	Metermetrics
MES	Marsh Electronics
MET	Metermaster
MIA	Mid-West Associated
NCE	North Coast Electric
NEI	Norvell Electronics
NEV	Nevada Electronics
NEW	Newark Electronics
NID	N.I.D.I.
NOR	North Supply
NRT	Northern Radio & TV
OLI	Olive Electronics
OLS	On-Line Int'l Inc.
OMG	Omega Engineering, Inc.
PAC	Pacer Industries, Inc.
PAL	Paloma Sales
PAN	Panterra Sales
PEE	Peerless Elect. Equip
PEL	Priest Electronics
PEP	Palomar Electronic Products
PIL	Pilgrim Electronics
PIN	Pioneer-Standard
PMC	Process Measurement Co.
PRI	Priority One Elec.
QUE	Quement Electronics
RAD	Radar Electric
RAG	Rag Enterprises
RAL	Ralph's Electronics
RAW	Rawson & Co.
REA	Redco East
RED	Redco
REM	REM Electronics
REP	Ragon Elect. Parts
RGB	RGB Electro-Industrial
RIO	Riordan Electronic Products
ROC	Aquas Electronics
ROM	Rome Electronics
ROU	Route Electronics
RPS	RPS Electronics
RRI	R&R Instrumentation
RSE	RS Electronics
SAS	S&S Electronics
SCO	Scott Electronics
SEE	Southeastern Elect.
SHD	Shand Electronics
SML	Standard Meter Lab
SOU	Southern Elect. Co.
SPD	Specialty Distributing
SPE	Specialized Products
SSC	Standard Supply Co.
STA	Stark Electronic Supply
STS	Scottsdale Tool & Supply
SUM	Summit Distributors
SUN	Sunshine Scientific
TAF	Taft Electronics
TAY	Taylor Elec. Co.
TEC	Techni-Tool
THA	ThermX of California
THX	ThermX Southwest
TKS	Tool Kit Specialists
TOO	Tool Tronics
TRA	Transcat
TRE	Tech. Representations
TRI	Tri-State Inst. Lab
TRO	Trott Electronics
TST	Test Equipment Service, Inc.
TUK	Tucker Electronics, Co.
TWE	Trice Wholesale Electronics
UNI	United Radio
USI	U.S. Instrument Rentals
VAN	Vanguard Electronic Tool
WAS	WASSCO
WBA	W.B. Allen Supply
WES	Wholesale Elec. Supply
WHO	Wholesale Electronics
WIE	Wholesale Ind. Elec.
WIS	Wise Components
WSJ	WS Jenks
WST	Western Elect. Supply
WYL	Wyle Lab Mkt. Group
YDI	You-Do-It Electronics
YIS	Y.I.S. Inc.
ZAC	Zack Electronics
ZKT	Zackit Electronics

ORDER WORK SHEET

Order from Fluke by contacting your nearest Fluke sales office listed on page 243. Products in this catalog marked "Available through Distributors" are in stock and ready for immediate delivery from one of the Fluke distributors listed on page 248.

Ordered by: DATE ______________________

NAME ______________________________________

Daytime phone (____) __________ , ext. ________

☎

Call

1-800-426-0361

Item	Qty	Model/Option Number	Catalog Page No.	Product Description or Title	Unit Price		Total	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Call Your Fluke Sales Office
listed on page 243 or
Call 1-800-426-0361
for assistance

BILL TO: (all invoices are automatically sent to your Accounts Payable Dept.)

Company Name

P.O. Box

Street Address

City State Zip

SHIP TO:

Company Name

Attn. of Bldg Dept/MS

Street Address

City State Zip

Special Shipping Instructions ______________________

HOW TO ORDER

7 Ways to Obtain Fluke Products

1. Fluke Sales Staff

Call the Fluke sales office nearest you listed on page 243. A Fluke sales engineer is ready to answer your questions and place an order for equipment that meets your application. The sales engineer is backed by application engineers and Fluke factory specialists who can help create solutions for your test, measurement, and control problems. For the Fluke sales office nearest you, call

800-426-0361

2. Fluke Distributors

Distributors in over 500 locations stock products marked "Available through Distributors" for immediate delivery. (To purchase distributor-sold products in quantities more than 50, contact your Fluke Sales Office.) For the Fluke distributor nearest you, call

800-426-0361

3. Telephone Ordering

The fastest, easiest way to order Fluke products is by telephone. A Fluke Sales Engineer can answer your questions and take your order. To order by telephone, call

800-44Fluke (800-443-5853)
Extension 701

4. Leasing

Leasing conserves capital, improves cash flow, keeps your credit line intact, and can be made to fit your budget. Call your Fluke sales office or

800-426-0361

5. OEM and Special Purchase Agreements

For a contract that will exactly fit your needs and give you the best multiple unit price, contact your Fluke sales office or 206-356-5491 or

800-426-0361

6. U.S. Government Purchasers

Most of the instruments in this catalog are available on General Service Administration Contracts. See page 240 for additional information or call your Fluke Sales Office.

We also have Basic Ordering Agreements, including our standard repair program, available for Department of Defense use.

7. Fluke Cooperative Services (FCS)

Fluke Cooperative Services (FCS) is a network of independent specialists who know hardware, who know software, and who know your industry. FCS is for project managers, production managers, systems engineers — anyone who needs total test, measurement, and control systems solutions. Call your Fluke sales office or

800-426-0361

Visit us

Fluke Exhibit Vans, Trade Shows, Factory Visits

Visit Fluke at one of the many trade shows we attend or see us when one of the Fluke vans is in your area. We also welcome you at the Fluke factory in Everett, Washington. You'll be able to use Fluke equipment and see first hand how it is engineered and manufactured. Contact your Fluke Sales Office for information on our trade show schedule, our van schedule, and on arranging a factory visit.

800-426-0361
For Product Information
and Where to Buy

800-443-5853
To Order by Telephone

800-843-2773
For Support Services
Assistance

800-526-4731
For Replacement Parts

Litho in U.S.A.

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